Volume 11
Number 1
2001

NOVON

New Combinations and New Names in Some Brazilian Microlicieae (Melastomataceae), with Notes on the Delimitation of *Lavoisiera*, *Microlicia*, and *Trembleya*

Frank Almeda

Department of Botany, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118-4599, U.S.A. falmeda@calacademy.org

Angela B. Martins

Departamento de Botânica, IB, Universidade Estadual de Campinas, Caixa Postal 6109, 13083-970 Campinas, São Paulo, Brazil. amartins@unicamp.br

ABSTRACT. Consideration of generic limits in the largely Brazilian tribe Microlicieae has resulted in an emended circumscription of the genus *Lavoisiera* to include those species with a capsule that dehisces longitudinally from the base to the apex, and an ovary that is always partly inferior with a persistent columella and laterally flattened lamelliform placental intrusions. An ongoing re-evaluation of *Lavoisiera* necessitates the transfer of seven species to *Microlicia* and one species to *Trembleya*. Six new combinations are proposed (*Microlicia cerifera*, *M. mucugensis*, *M. noblickii*, *M. ordinata*, *M. vernicosa*, and *Trembleya elegans*), and two new names are provided (*Microlicia giuliettiana* and *M. longipedicellata*) for epithets already pre-empted in the genus to which they are being transferred. Generic limits in *Microlicia* and *Trembleya* are also discussed, together with distributional notes and diagnostic characters for the species here transferred to these genera.

Key words: Brazil, *Lavoisiera*, Melastomataceae, *Microlicia*, Microlicieae, *Trembleya*.

The Microlicieae, with over 250 species, is the largest tribe of capsular-fruited Melastomataceae with a distribution centered in Brazil. Previous classifications of the family have attributed between 11 and 15 genera to this tribe (Cogniaux, 1891; Renner, 1993), which has traditionally been defined by its terete capsules, unadorned ovary apex, prolonged anther connectives, rostrate anther thecae, and oblong or reniform seeds with a predominantly foveolate testa.

We are currently preparing a monograph of *Lavoisiera* DC., a genus of the Microlicieae with some 76 validly published species that is essentially restricted to campo rupestre habitats in central Brazil. Campo rupestre is a species-rich formation of interdigitating vegetation types dictated by slope, aspect, and drainage that is dominated by quartzitic outcrops with sandy or gravelly soils that are nutrient-poor (Giulietti et al., 1987; Giulietti & Pirani, 1997; Stannard, 1995).

The imprecise circumscription of genera in the Microlicieae has long been recognized (Baillon, 1877; Baumgratz et al., 1996; Hooker, 1867), yet no studies have attempted to evaluate intergeneric relationships within the tribe. To better understand the relationships and systematic position of *Lavoisiera*, we have conducted a comprehensive character analysis of all genera attributed to the Microlicieae in the past. Although our work is still in progress, our phylogenetic analyses using morphological characters show that *Lavoisiera* is consistently part of a clade that includes *Chaetostoma* DC., *Microlicia* D. Don, *Rhynchanthera* DC., *Sten-*

odon Naudin, and *Trembleya* DC. The remaining genera that have traditionally been included in the Microlicieae (*Bucquetia* DC., *Cambessedesia* DC., *Castratella* Naudin, *Eriocnema* Naudin, and *Lithobium* Bongard) by Cogniaux (1891) and Renner (1993) are more distantly related to *Lavoisiera*. Assignment of these discordant genera to other capsular-fruited tribes such as the Melastomeae and Sonerileae (including Bertolonieae) may be necessary when seed characters are better understood. Of the five other genera with which *Lavoisiera* forms a distinctive clade, it appears to be most closely related to *Microlicia* and *Trembleya*. Within this group of three genera, *Lavoisiera* is distinguished by a capsular fruit that always dehisces in acropetal fashion from the base to the apex. It has a 4- to 8-locular ovary that is always partly inferior (generally ¾ inferior but always at least ½ inferior), a persistent columella (the central axis around which the carpels are arranged), and placentae in each ovary locule that form laterally flattened lamelliform (platelike) intrusions. The flowers of *Lavoisiera* are typically 5- to 8-merous, rarely 9-merous. Many of the features that we use to characterize *Lavoisiera* were also enumerated by Naudin (1844). However, Naudin (1844) noted that the ovary of some species of *Lavoisiera* is 3-locular, and Cogniaux (1883) described and illustrated the ovary as 2-locular in a few species. We have been unable to verify the presence of a 2- or 3-locular ovary in any species of *Lavoisiera* and strongly suspect these were erroneous observations.

With the exception of *Lavoisiera*, which is unique in the family, all other capsular-fruited melastomes exhibit basipetal dehiscence from the apex to the base of the capsule. Previous students of the Melastomataceae have provided no insights on the biological significance of basal capsule dehiscence. We have given much thought to whether this extraordinary mode of fruit dehiscence has any adaptive significance. *Lavoisiera* differs from other capsular-fruited melastomes of campo rupestre habitats in having ovaries that are partly inferior. This partially inferior ovary creates a fruiting structure that is typically thick-walled for ½ to ¾ of its length. Thus, one possible advantage of basal capsule dehiscence is that it may promote rapid evacuation of mature seeds from the capsule. Apical dehiscence of a partly inferior capsular fruit with a similarly thick wall, on the other hand, creates a sturdier poorly dehiscent structure that would hold water longer and serve as a reservoir for the growth of destructive fungi and bacteria.

In *Microlicia*, capsule dehiscence is always longitudinal from the apex to the base, the ovary is always superior, the columella is deciduous, and the placentae in each ovary locule are dorso-ventrally compressed and sometimes subpeltate. The flowers are typically 5-merous, very occasionally 6-merous, and 8-merous in one species. The ovary in *Microlicia* is typically 3-locular, rarely 3- and 4-locular on the same individual, and 5-locular in a few species.

All of the largely Brazilian genera of Microlicieae were probably derived from ancestral stock that was morphologically similar in many respects to *Trembleya*. This genus has capsules that dehisce basipetally from the apex to the base, the ovary is always superior, the columella is deciduous, the placental intrusions in each ovary locule are subpeltate, the ovary is 3- to 5-locular, and the flowers are typically 5-merous, although two species are 4- or 5-merous. Other plesiomorphic characters of *Trembleya* are its pedicellate to subsessile flowers borne in dichasia or reduced modifications of dichasia and the bracts and bracteoles that subtend nodes and pedicels of the inflorescence, respectively. This is in contrast to the situation in *Microlicia* where the pedicellate to subsessile flowers are solitary and never subtended by modified leaves. *Lavoisiera* is more complex in this regard. It has two species with congested dichasia and associated bracts and bracteoles. A great majority of its 35 to 40 species, however, have sessile solitary flowers that are typically subtended by modified leaves (bracts).

The parallelisms in character states exhibited by these three genera are not unexpected in closely related taxa that have adapted to similar environments with high insolation, pronounced seasonal rainfall, and a landscape characterized by a mosaic of nutrient-poor soils and highly dissected topography. *Lavoisiera*, *Microlicia*, and *Trembleya* have some consistent diagnostic characters that facilitate generic separation. They also exhibit some modally distinctive, but not always mutually exclusive, differences in floral merosity and ovary locule number that are clearly homoplasious. This has made the placement of anomalous or seemingly intermediate species difficult or arbitrary at times. The recognition of *Lavoisiera* as a natural genus is clearly defensible. The relationship between *Microlicia* and *Trembleya*, however, is very close. At this point in our studies of the Microlicieae, we defer to the judgment of a recent monographer (Martins, 1997) and recognize *Trembleya* at the generic level pending the results of molecular data. Using the character combinations enumerated above, we have been able to confidently place all described species of *Lavoisiera* into one of the three genera discussed

here. This has been possible even in the few cases where mature fruiting material was lacking. Based on our revised generic circumscription, we herein propose the transfer of seven species of *Lavoisiera* to *Microlicia* and one to the genus *Trembleya.*

Microlicia cerifera (Gardner) A. B. Martins & Almeda, comb. nov. Basionym: *Lavoisiera cerifera* Gardner, Sertum Plantarum part 3, tab. 63, 1844. TYPE: Brazil. Minas Gerais: elevated mountain tracts NW of Diamantina, July 1840, *G. Gardner 4581* (holotype, BM; isotypes, B-destroyed, F-frag., photo negative F 16653, K, NY, US).

Distribution and phenology. Known only from the type, which was collected in flower in July.

In the protologue, Gardner emphasized that this species differed from other described species of *Lavoisiera* by its 3-celled ovary, but he expressed no doubts about his generic placement of the taxon. The 5-merous solitary flowers, lack of bracteoles, and 3-locular ovary of this species clearly dictate placement in *Microlicia.* None of the type specimens have capsules that are sufficiently mature to determine the exact nature of capsule dehiscence, but we feel confident that they will prove to be apically dehiscent when good fruiting material comes to light. In addition to the above characters, *M. cerifera* is distinguished by its 3-nerved leaves that are sessile and semiamplexicaul.

Microlicia giuliettiana A. B. Martins & Almeda, nom. nov. Basionym: *Lavoisiera luetzelburgii* Markgraf, Notizbl. Bot. Gart. Berlin-Dahlem 10: 47. 1927. TYPE: Brazil. Bahia: 1914, *P. Luetzelburg 286* (holotype, M).

Distribution and phenology. Endemic to the Chapada Diamantina in Bahia, Brazil, from the vicinity of Lençois and Mucugê west to Piatã and south to Pico das Almas and the vicinity of Rio de Contas where it is locally common in campo rupestre and grassy slopes at 700–1850 m. Flowering from January through August, with an apparent peak in March, and in November and December; fruiting in December, February, March, and July (the peak month) and probably intervening months.

A new name, *Microlicia giuliettiana,* is provided for this species because the basionym is already pre-empted by *M. luetzelburgii* Markgraf (Markgraf, 1927). Markgraf's placement of this species in *Lavoisiera* is puzzling because he described it as having solitary 5-merous flowers and a 3-locular ovary, characters traditionally associated with *Microlicia.* Our examination of material consistently shows that the capsules dehisce from the apex to the base, the ovary is superior, the columella is deciduous, and the placental intrusions are dorso-ventrally compressed. Thus, its placement in *Microlicia* is clearly warranted. Woodgyer (1995) also questioned the generic placement of *Lavoisiera luetzelburgii* and suggested that it might be more appropriately accommodated in *Microlicia.*

The unusual petal color pattern in this species is one of its most distinctive features. The petals are magenta pink when expanded with an abaxial red band or stripe on one side of each petal. The red band is typically all that is visible on floral buds and superficially gives the appearance that the petals are dark red. Other diagnostic features of this species are its obovate to broadly elliptic leaves that are apically rounded and mucronate with crenate to serrate margins beset with gland-tipped hairs.

We take pleasure in naming this species for our colleague, Ana Maria Giulietti, in recognition of her many contributions to botanical research, the training of many young Brazilian botanists, and her long-time efforts to promote an understanding of the rich campo rupestre flora in the states of Minas Gerais and Bahia, Brazil.

Representative specimens examined. BRAZIL. **Bahia:** Município de Lençois, estrada de Lençois BR 242, 5 km ao N de Lençois, 19 Dec. 1981, *Carvalho et al. 993* (CEPEC, US); região da Serra Sincorá, entre Ibyquara e Mucugê, 17 Feb. 1943, *Fróes 20163* (US); Município de Piatã, Serra do Atalho, próximo ao Garimpo da Cravada, 13°07′S, 41°54′W, 21 Aug. 1992, *Ganev 926* (CAS, HUEFS); 8 km SW of Mucugê on road from Cascavel near Fazenda Paraguacú, 41°25′W, 13°02′S, 6 Feb. 1974, *Harley 16078* (CEPEC, NY, US); lower NE slopes of the Pico das Almas, ca. 25 km WNW of the Vila do Rio de Contas, 41°57′W, 13°33′S, 17 Feb. 1977, *Harley et al. 19503* (CEPEC, NY, US); Serra do Lençois, lower slopes of Morro do Pai Inácio ca. 14.5 km NW of Lençois just N of the main Seabra–Itaberaba road, 41°28′W, 12°27′S, 21 May 1980, *Harley et al. 22243* (CEPEC, UEC, US); Município de Piatã, estrada para Inóbia ca. 31 km de Piatã, 15 Feb. 1987, *Harley et al. 24278* (CAS); Município Rio de Contas, Mato Grosso, 16 May 1983, *Hatschbach 46513* (CEPEC, MICH, US).

Microlicia longipedicellata Almeda & A. B. Martins, nom. nov. Basionym: *Lavoisiera glutinosa* Cogniaux, in Mart. Fl. Bras. 14(3): 145. 1883. TYPE: Brazil. Minas Gerais: in locis saxosis prope Tejuco [Diamantina], Dec. 1824, *L. Riedel 1224* (holotype, LE not seen, photo negative F 16660; isotypes, C, M, MO, NY, US, W).

Distribution and phenology. Known only from the type and two other collections made in 1937,

all of which come from the Diamantina plateau in Minas Gerais, Brazil. These collections were gathered in November and December. Collections from both months have flowers; one of the collections made in December has persisting old capsules.

In transferring *Lavoisiera glutinosa* Cogniaux to *Microlicia* we are providing a new name, *Microlicia longipedicellata*, because *Microlicia glutinosa* Naudin is already pre-empted (Naudin, 1845: 180). In the protologue of *Lavoisiera glutinosa*, Cogniaux stated that the capsule opens from the base. This and the purported 6-locular ovary were probably the characters that prompted him to assign it to *Lavoisiera*. Our observations indicate that the capsules actually dehisce from the apex to the base. This kind of capsule dehiscence together with the ebracteate flowers, dehiscent columella, dorso-ventrally compressed placentae, and superior ovary leave no doubt that *L. glutinosa* should be placed in the genus *Microlicia* as we circumscribe it. *Microlicia longipedicellata* also has an 8-merous flower and an ovary that is 5-locular, character states that are common in species of *Lavoisiera* but uncommon in *Microlicia*. In the past, a tendency to emphasize floral merosity and ovary locule number, to the exclusion of other characters, has led to the placement of anomalous species like this one in *Lavoisiera* instead of *Microlicia*.

The specific epithet, *longipedicellata*, calls attention to the persistent elongate pedicels of this species that measure 5–10 mm long. *Microlicia longipedicellata* is also distinctive in having quadrate upper cauline internodes, glutinous trinerved leaves that are glandular-punctate with a conspicuous network of prominulous venules on the abaxial surface, and triangular-subulate calyx lobes.

Representative specimens examined. BRAZIL. **Minas Gerais:** Sentinella, Diamantina, 8 Nov. 1937, *Mello Barreto 9575* (BHMH); Rio Grande, Diamantina, 8 Dec. 1937, *Mello Barreto 10074* (F).

Microlicia mucugensis (Wurdack) Almeda & A. B. Martins, comb. nov. Basionym: *Lavoisiera mucugensis* Wurdack, Phytologia 64: 294. 1988. TYPE: Brazil. Bahia: Mucugê, Corrego Moreira, 22 Jan. 1984, *G. Hatschbach 47502* (holotype, MBM; isotypes, C, CEPEC, HUEFS, US).

Distribution and phenology. Endemic to the Chapada Diamantina in Bahia, Brazil, from Andaraí and Mucugê south toward Jussiape in campo rupestre at 900–1200 m. Flowering specimens have been collected in January, July, and September; good fruiting material has been collected in May but specimens collected in January also have old fruits.

In addition to its 5-merous flower and 5-locular ovary, *Microlicia mucugensis* is distinguished by its viscose-punctate leaves that are sessile, ovate-oblong, and cordulate at the base, as well as its completely yellow anther thecae.

Wurdack's (1988) decision to place this species in *Lavoisiera* was evidently influenced by ovary locule number as the character of importance for generic placement in the Microlicieae. On the basis of other fixed characters such as the apically dehiscent capsules, superior ovary, deciduous columella, and subpeltate placental intrusions, none of which were considered diagnostic by Wurdack, assignment of this species to *Microlicia* is consistent with our circumscription of these genera.

In the protologue, Wurdack noted that *M. mucugensis* is most closely related to *Lavoisiera glutinosa* (in agreement with our transfer of the latter to *Microlicia* as *M. longipedicellata*). The latter species differs in its 6-merous flowers, ovate leaf blades that taper to the base, and well-developed pedicels (5–10 mm). Wurdack also emphasized the strong vegetative resemblance between *M. mucugensis* and *M. hatschbachii* Wurdack, noting that the latter species has a 3-locular ovary, basally acute leaves, and shorter deltoid calyx lobes.

Representative specimens examined. BRAZIL. **Bahia:** entre km 5–15 road, Mucugê rodovia para Andaraí, 15 Sep. 1985, *Hatschbach 48248* (C, US); Município de Mucugê, 3 km ao S de Mucugê, na estrada para Jussiape, 13°00′S, 41°24′W, 26 July 1979, *Mori et al. 12559* (US); Município de Mucugê, nova rodovia Mucugê/Andaraí entre os km 0 e 10, 19 May 1989, *Silva et al. 2774* (UB).

Microlicia noblickii (Wurdack) A. B. Martins & Almeda, comb. nov. Basionym: *Lavoisiera noblickii* Wurdack, Kew Bull. 50: 821. 1995. TYPE: Brazil. Bahia: Palmeiras, 19 Nov. 1983, *L. R. Noblick & A. Pinto 2769* (holotype, HUEFS; isotypes, CAS, CEPEC, US).

Distribution and phenology. Endemic to the Chapada Diamantina in Bahia, Brazil, where it has been collected on and near Morro do Pai Inácio in campo rupestre off the road between Lençois and Palmeiras at 1000–1200 m. Flowering specimens have been collected in October and November; fruiting material has been collected in June with some October collections in old fruit.

This species, like *M. mucugensis*, has 5-merous flowers and a 5-locular ovary. It is transferred to *Microlicia* for the same reasons enumerated in the discussion following that species. In his 1988 protologue of *Lavoisiera mucugensis*, Wurdack also

noted that these two species are closely related. We agree with his assessment of interspecific relationships although we disagree with his placement of both species in *Lavoisiera*. *Microlicia noblickii* differs from *M. mucugensis* in having larger leaf blades (12–16 × 10–11 mm vs. 7–10 × 6–8 mm), different calyx lobes (deltoid vs. lanceolate), and a longer connective prolongation on the larger anthers (7 mm vs. 3.8–4.2 mm).

Microlicia noblickii also differs from *M. mucugensis* in its polysporangiate anthers. *Microlicia mucugensis*, like the majority of angiosperms and presumably most Melastomataceae, has tetrasporangiate anthers. Baumgratz et al. (1996) first described polysporangiate (multilocular) anthers in the family for two species of *Chaetostoma* and 14 species of *Microlicia*. The anthers of species that are polysporangiate have both of their thecae divided into numerous small locules in a way that resembles the structure of a honeycomb. The biological significance of polysporangiate anthers is unclear at present. Vibrational pollination by bees is common in the Melastomataceae, and we have observed buzzing bees visiting flowers of *Microlicia* and *Chaetostoma* in the field. In polysporangiate anthers, Baumgratz et al. (1996) speculated that compartmentalization of the thecae would reduce the chance that all pollen is removed by the first insect visitor to a flower. Thus staggered pollen presentation would insure pollen availability to more than one visitor and ultimate deposition on more than one stigma.

Two of the species treated here, *M. noblickii* and *M. ordinata*, can now be added to the list of congeners with polysporangiate anthers. As Baumgratz et al. noted, the polysporangiate condition in the Microlicieae may ultimately prove to be of taxonomic utility, at the species level at least. Our survey of anther morphology in all species that we assign to *Lavoisiera* reveals that they are all tetrasporangiate. This corroborates and extends the findings of Baumgratz et al. who encountered only tetrasporangiate anthers in the 12 species of *Lavoisiera* examined for their study.

Representative specimens examined. BRAZIL. **Bahia:** Município Palmeiras, Morro do Pai Inácio–Platô Cruz, 5 Jan. 1997, *Conceição 218* (SPF); Município Palmeiras, Pai Inácio, 41°28′17″W, 12°27′31″S, 21 Nov. 1994, *Melo et al. 1197* (ALCB); E-facing slope just below TV transmission tower N of BR 242, ca. 5 km W of paved road to Lençois, 9 Nov. 1988, *Kral et al. 75606* (US); Município of Palmeiras, Pai Inácio, BR 242, W of Lençois at km 232, 12 June 1981, *Mori & Boom 14368* (US).

Microlicia ordinata (Wurdack) Almeda & A. B. Martins, comb. nov. Basionym: *Lavoisiera ordinata* Wurdack, Phytologia 29: 135. 1974. TYPE: Brazil. Goiás: Chapada dos Veadeiros, rocky slopes, 15 km W of Veadeiros, elev. 1000 m, 12 Feb. 1966, *H. S. Irwin et al. 12695* (holotype, US; isotypes, F, MO, NY, RB, S, W).

Distribution and phenology. Endemic to the Chapada dos Veadeiros in Goiás, Brazil, where it is locally common in wet campo (brejo), grassy seeping slopes, wet sandy or rocky soil, and rocky slopes (campo rupestre) at 1000–1600 m. Flowering collections have been made from February through April; fruiting material has been collected in July and October.

Microlicia ordinata, like *M. mucugensis* and *M. noblickii*, also has a 5-merous flower and a 5-locular ovary. Again, we suspect that the latter character figured prominently in Wurdack's (1974) decision to assign it to *Lavoisiera* instead of *Microlicia*. An examination of other diagnostic characters shows that it has a superior ovary, apical capsule dehiscence, a deciduous columella, and dorso-ventrally compressed placental intrusions. In Wurdack's (1959) initial attempt to place this species generically, he commented on its superficial resemblance to *Microlicia macrophylla* Naudin, which has a 3-locular ovary. In the protologue he compared *Lavoisiera ordinata* to *L. bicolor* Naudin. The latter species, which appears to be known only from the type, has a 6-merous flower and a 6-locular ovary (Cogniaux, 1883). Wurdack also commented on the resemblance of *L. ordinata* to *M. pilosissima* Cogniaux, a rare species that also has a 3-locular ovary.

Some of the salient characters of *M. ordinata* include its 4-winged upper internodes, ovate-orbicular, glandular pubescent leaves (0.5–1.4 cm long), short calyx lobes (1–2.8 cm), and a conspicuously 5-lobulate ovary apex. The anthers of *M. ordinata* are polysporangiate like those described above for *M. noblickii*.

The chromosome number of *M. ordinata* was reported as $n = 12$ under the genus *Lavoisiera* (Almeda, 1997). A gametic number of 12 is known for several species of *Chaetostoma*, *Lavoisiera*, *Microlicia*, and *Trembleya* and appears to be the base number in the Microlicieae (Almeda, Martins & Romero, unpublished).

Representative specimens examined. BRAZIL. **Goiás:** 20 km by road N of Alto Paraíso, 5 Mar. 1973, *Anderson et al. 6381* (C, F, MO, NY, RB, US); 15 km S of Veadeiros, road to São João de Aliança, 19 Mar. 1969, *Irwin et al. 24639* (CAS); Chapada dos Veadeiros, rodovia GO-118, 4 km N de Alto Paraíso, 10 Feb. 1994, *Hatschbach & Silva*

60297 (HUEFS); Chapada dos Veadeiros, 10 Km N of Alto Paraíso, 24 Jan. 1980, *King & Almeda 8275* (CAS, M, MO, UB, US).

Microlicia vernicosa (Barreto ex Pedersoli) A. B. Martins & Almeda, comb. nov. Basionym: *Lavoisiera vernicosa* Barreto ex Pedersoli, Oréades 7 (12/13): 25–28. 1979/1980. TYPE: Brazil. Minas Gerais: Serra do Cipó, 13 Aug. 1933, *H. L. M. Barreto 325* (holotype, BHMH).

Distribution and phenology. Known only from the type, which was collected in flower in August.

The protologue notes that fruits of this species were not seen. We suspect that its placement in *Lavoisiera* was probably based on its 6-merous flowers. Although the mode of capsule dehiscence cannot be determined on the basis of material at hand, it is clear that this species has a 3-locular ovary, which is never found in *Lavoisiera.* Because the ovary of *M. vernicosa* is superior, the ovary placentae are dorso-ventrally compressed, and the flowers are not subtended by bracts, we infer that this species will exhibit all the diagnostic characters that we attribute to *Microlicia* when fruiting material comes to light.

In the protologue, *M. vernicosa* is compared with *L. glutinosa* (here transferred to *Microlicia* as *M. longipedicellata*). Both of these species have glutinous leaves and flowers that are solitary but aggregated in uppermost leafy branches. In *M. longipedicellata* the flowers are 8-merous, the ovary is 5-locular, the leaves are entire (vs. serrulate in *M. vernicosa*), and the pedicels are 5–10 mm (vs. 1–2 mm) long.

Trembleya elegans (Cogniaux) Almeda & A. B. Martins, comb. nov. Basionym: *Lavoisiera elegans* Cogniaux, in Mart. Fl. Bras. 14(3): 160–161. 1883. TYPE: Brazil. Goiás: *A. F. Glaziou 3758* (holotype, BR; isotype, C).

Distribution and phenology. Probably widespread from the Carrancas region of southern Minas Gerais, Brazil, northwest to Serra da Canastra and north to an unspecified locality in Goiás state in campo rupestre and seasonally wet campo at 1000 m. Flowering material has been collected from February through May and in October and November; fruiting material has been gathered in September and October.

In the protologue, the type is cited as being from Rio de Janeiro but the label on the holotype gives the locality as Goiás. No recently collected material has been seen from that state but six collections were made in Minas Gerais from 1996 through 1998. Cogniaux (1883) described this species as having solitary 4- or rarely 5-merous flowers, and a 4-locular ovary that is ½ inferior. The type does have a 4-locular ovary but it is superior. All recent collections of *T. elegans* have a superior 5-locular ovary, an apically dehiscent capsule, and 5-merous flowers borne in dichasia with bracts subtending the inflorescence nodes and bracteoles subtending floral pedicels. The ovary also has subpeltate placental intrusions that are typical of *Trembleya.*

Until 1996, *T. elegans* was known only from the type and one other collection. This probably accounts for the fact that its discordant position in *Lavoisiera* was not discovered for over 100 years. Its apparent rarity is also suggested by the fact that it is not conspecific with any of the described species of *Trembleya* recently treated by Martins (1997).

Representative specimens examined. BRAZIL. **Goiás:** in 1894–95 without a specific locality, *Glaziou 25297* (BR). **Minas Gerais:** Município de Carrancas, caminho para Gruta da Ponte, 22 May 1997, *Matsumoto et al. 293* (CAS); Município de Carrancas, Poço da Ponte, 13 Sep. 1997, *Matsumoto 422* (UEC); Município de Carrancas, Poço da Ponte, 44°39′W, 21°28′S, 10 Oct. 1997, *Matsumoto et al. 487* (CAS); Município de Carrancas, Poço da Ponte, 10 Nov. 1997, *Matsumoto et al. 503* (UEC); Município de Carrancas, Toca da Ponte, 6 Feb. 1998, *Matsumoto et al. 655* (UEC); Parque Nacional da Serra da Canastra, São Roque de Minas, 24 Mar. 1996, *Nakajima & Romero 1729* (CAS).

Acknowledgments. Fieldwork for this study was funded by the National Geographic Society (NGS Grant 6173-98 to Almeda). We are grateful to the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) for a postdoctoral grant (No. 99/0694-3) to Martins that made this collaborative project possible during her extended stay at the California Academy of Sciences. Martins also thanks the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq Grant No. 301346/86-0) for supporting her taxonomic studies of Melastomataceae. We also thank the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) for permission to collect in protected areas of Brazil, the Universidade Estadual de Campinas, and the California Academy of Sciences for logistical and facilities support, and the following individuals who helped with many aspects of two recent field expeditions to Brazil: Orbélia Robinson, Don Robinson, Rosana Romero, Paulo J. F. Guimarães, Renato Goldenberg, Renato Belinello, and Jimi N. Nakajima. We also thank the curators and staffs of the following herbaria for loans, gifts, or special assistance during study visits: ALCB, B, BHCB, BHMH, BM, BR, C, CAS, CEPEC, DS, ESA, F, HUEFS, HUFU, K, M,

MBM, MICH, MO, NY, R, RB, S, SP, SPF, UB, UEC, US, W.

Literature Cited

Almeda, F. 1997. Chromosome numbers and their evolutionary significance in some neotropical and paleotropical Melastomataceae. BioLlania Ed. Esp. N° 6: 167–190.

Baillon, H. E. 1877. Mélastomacées. Hist. Pl. 7: 1–65. L. Hachette et Cie, Paris, London & Leipzig.

Baumgratz, J. F. A., M. L. D. R. Souza, E. M. Woodgyer & E. M. Nic Lughadha. 1996. Polysporangiate anthers: Described for the first time in Melastomataceae. Kew Bull. 51: 133–144.

Cogniaux, A. 1883. Melastomaceae (Microlicieae). *In*: C. F. P. von Martius, Flora Brasiliensis 14(3): 1–204.

———. 1891. Mélastomacées. *In*: A. & C. de Candolle (editors), Monographiae phanerogamarum 7: 1–1256. G. Masson, Paris.

Giulietti, A. M. & J. R. Pirani. 1997. Espinhaço Range Region, Eastern Brazil. Pp. 397–404 *in* S. D. Davis, V. H. Heywood, O. Herrera-MacBryde, J. Villa-Lobos & A. C. Hamilton (editors), Centres of Plant Diversity: A Guide and Strategy for Their Conservation (Vol. 3. The Americas). The World Wide Fund for Nature (WWF) and IUCN-The World Conservation Union. IUCN Publications Unit, Cambridge, U.K.

———, N. L. Menezes, J. R. Pirani, M. Meguro & G. L. Wanderley. 1987. Flora da Serra do Cipó, Minas Gerais: Caracterização e lista das espécies. Bol. Bot. Univ. São Paulo 9: 1–151.

Hooker, J. D. 1867. Melastomaceae. *In*: G. Bentham & J. D. Hooker, Genera Plantarum 1: 725–773.

Markgraf, 1927. Melastomataceae (*Microlicia*). *In*: R. Pilger (editor), Plantae Luetzelburgianae Brasilienses VII. Notizbl. Bot. Gart. Berlin-Dahlem 10: 45–47.

Martins, E. 1997. Revisão Taxonômica do Gênero *Trembleya* DC. (Melastomataceae). D.Sc. Thesis, Univ. Estadual de Campinas, São Paulo, Brazil.

Naudin, C. V. 1844. Additions à la flore du Brésil Méridional. Ann. Sci. Nat. Bot., Sér. 3, 2: 148–156.

———. 1845. Additions à la flore du Brésil Méridional. Ann. Sci. Nat. Bot., Sér. 3, 3: 169–192.

Renner, S. S. 1993. Phylogeny and classification of the Melastomataceae and Memecylaceae. Nordic J. Bot. 13: 519–540.

Stannard, B. L. (editor). 1995. Flora of the Pico das Almas. Chapada Diamantina–Bahia, Brazil. Royal Botanic Gardens, Kew.

Woodgyer, E. 1995. Melastomataceae (*Lavoisiera*). Pp. 441–445 *in* B. L. Stannard (editor), Flora of the Pico das Almas. Chapada Diamantina–Bahia, Brazil. Royal Botanic Gardens, Kew.

Wurdack, J. J. 1959. The Machris Brazilian Expedition: Phanerogamae, Melastomataceae and Polygalaceae. Los Angeles County Mus. Contr. Sci. 28: 3–11.

———. 1974. Certamen Melastomataceis XXIII. Phytologia 29: 135–151.

———. 1988. Certamen Melastomataceis XXXVIII. Phytologia 64: 293–301.

Passiflora tarminiana, a New Cultivated Species of *Passiflora* subgenus *Tacsonia* (Passifloraceae)

Geo Coppens d'Eeckenbrugge and Victoria E. Barney
CIRAD-FLHOR/IPGRI Project for Neotropical Fruits, c/o CIAT, A.A. 6713, Cali, Colombia

Peter Møller Jørgensen and John M. MacDougal
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. The new species *Passiflora tarminiana* differs from its closest relative by the character combination of very small acicular stipules and large reflexed petals and sepals. This species has escaped detection despite being widely cultivated in South America. Naturalized populations, particularly in Hawai'i, have created problems for conservation of the native flora. In Colombia it is more frequently adopted in industrial cultivation because of its unusual vigor and resistance to fungal diseases.

RESUMEN. La nueva especie *Passiflora tarminiana* difiere de su pariente más cercano por la combinación de caracteres de las estípulas aciculares muy pequeñas y los pétalos y sépalos grandes y reflexos. Esta especie ha escapado su descubrimiento a pesar de estar extensamente cultivada en América del Sur. Las poblaciones naturalizadas, particularmente en Hawai, han creado problemas para la conservación de la flora nativa. En Colombia se adopta mas frecuentemente en el cultivo industrial debido a su extremo vigor y resistencia a las enfermedades causadas por hongos.

Key words: Hawaii, *Passiflora*, Passifloraceae, South America, tropical fruit.

Passifloras of the subgenus *Tacsonia* are cultivated by many small farmers, from Venezuela to Bolivia. Some species are cultivated in New Zealand (Young, 1970). The main cultivated species was earlier known as *Passiflora mollissima* (Kunth) Bailey (Escobar, 1980, 1988; Jaramillo, 1957), but which we now prefer to recognize as *P. tripartita* var. *mollissima* (Kunth) Holm-Nielsen & P. Jørgensen as supported by analysis of morphological (Holm-Nielsen et al., 1988; Villacis et al., 1998) and genetic character states (Fajardo et al., 1998; Sánchez et al., 1999). It is called "curuba de Castilla" in Colombia, "tacso de Castilla" in Ecuador, and "banana passion fruit" in English-speaking countries. The second species of importance in the Andes is "curuba india," "curuba ecuatoriana," or "curuba quiteña" in Colombia, called "tacso amarillo" in Ecuador (Pérez Arbeláez, 1978; A.A.A., 1992; Campos, 1992), and "banana liliko'i" or "banana poka" where introduced in Hawai'i (La Rosa, 1984). It is most frequently found in private gardens, but some commercial growers have, because of its wild-type vigor, started to grow it instead of the "curuba de Castilla," *P. tripartita* var. *mollissima*. We describe this overlooked cultigen as a new species under the name *Passiflora tarminiana*, in recognition of Tarmín Campos (b. 1947), a Colombian agronomist and professor who has contributed enthusiastically for the past 20 years to the development of banana passion fruit cultivation and introduced the first author to the cultivated passifloras of the central Colombian highlands.

Producers and consumers easily differentiate *Passiflora tarminiana* from *P. tripartita* var. *mollissima*, but it has never been mentioned as a distinct species in taxonomical studies. In a letter to Tarmín Campos, Linda de Escobar considered it to be a hybrid of *P. tripartita* var. *mollissima*, possibly with the relatively glabrous *P. cumbalensis* (H. Karsten) Harms (in litt., 28 June 1990). The monographer Killip usually referred it to *P. mollissima*, but occasionally annotated specimens (e.g., *MacDaniels 635*) as "a hybrid between *P. mollissima* and some other species of the *Tacsonia* group." Green (1972: 556) suggested that it be "best treated as a part of the variable *P. mixta* [complex]." The new species has been described as a cultivar in Hawai'i, *P. mollissima* 'Banana Poka' (Grierson & Green, 1996). They considered it a probable hybrid, suggesting that it is not *P. mollissima* but that "it now seems probable that it arose in the wild by introgressive hybridization between this species and some other" (Grierson & Green, 1996: 92–93, pl.). We have observed *P. tarminiana* almost everywhere in the Colombian highlands, as well as in the Andes of Venezuela, southern Ecuador, and Peru, consistently with distinct phenotypic traits (see Table 1). Plants grown from seeds show no segregation for these phenotypic traits, which would not be the case with a hybrid. Recent morphological and

Table 1. Morphological comparison of three common or cultivated species of *Passiflora* subg. *Tacsonia*. Lettered numbers refer to the *R.H.S. Colour Chart* (1966).

	P. tarminiana	*P. tripartita*	*P. mixta*
Stem	Terete	Terete	Sub 5-angular
Leaf pubescence	Absent or nearly so on upper surface, moderate on lower surface	Var. *mollissima*: dense on both sides; other varieties: variable, often glabrous at least on upper surface	Absent on upper surface, often absent to rarely dense on lower surface
Stipules	Small (4–7 mm long, 2–3 mm wide), subreniform, denticulate or serrulate, deciduous	Medium (6–12 mm long, 13–19 mm wide), reniform, serrulate to serrate, persistent	Medium to large (6–20 mm long, 12–30 mm wide), reniform, dentate or serrate, persistent
Peduncle	Slender, variable in length, flower pendent	Slender, short, flower pendent	Stout, variable in length, flower half-pendent to erect
Bracts	United ½ their length or more	United ½ their length or more	United ¾ their length or more
Corolla color	Light pink (red-purple group, 57D, 66D, 74D, 75A/B/C), very rarely white	Pink to magenta (red-purple group, 57C/D, 62A, 65A, 66C–D, 68B, 70D for var. *mollissima*, 53B for var. *azuayensis* Holm-Nielsen & Jørgensen, 58B for var. *tripartita*)	Light pink to bright red (most often red/orange-red group, 39A, 42A, 50A, 51B, 52B, 54A, 54B, 55A, also red-purple group in southern Colombia and Ecuador, 63C/D, 75B)
Corolla shape	Corolla reflexed	Corolla campanulate	Corolla campanulate
Floral tube/sepal ratio	Tube/sepal length ratio ca. 1.3–1.6	Tube/sepal length ratio ca. 2.4–3.2	Tube/sepal length ratio ca. 1.6–2.6
Nectary chamber	Appreciably wider than floral tube	Slightly wider than floral tube	Slightly wider than floral tube
Fruits	Pericarp yellow, sometimes orange-tinged; arils orange, succulent	Pericarp pale yellow (var. *mollissima*) to yellow (var. *tripartita*); arils orange, succulent	Pericarp often green at maturity, sometimes turning yellow; arils gray to orange, scant

isozyme studies have confirmed that *P. tarminiana* is distinct from other common species of subgenus *Tacsonia*, such as *P. tripartita* var. *mollissima*, *P. mixta* L.f., *P. cumbalensis*, and *P. pinnatistipula* Cavanilles (Segura et al., 1998; Villacis et al., 1998).

Passiflora tarminiana Coppens & Barney, sp. nov. TYPE: Colombia. Valle del Cauca: Tenerife (municipio El Cerrito), under cultivation, 2200–2600 m, 3°43.189′N, 76°04.482′W, 8 Mar. 1999, *Coppens IPGRI-AM 72* (holotype, COL; isotypes, AAU, AK, BISH, CUZ, GOET, HUA, *IPGRI*, K, MEXU, MO, MYF, QCA, QCNE, TEX, US, VALLE, VEN). Figures 1–3. Table 1.

Passiflora mollissima (Kunth) L. H. Bailey cv. 'Banana Poka' Anon., in Grierson & Green, Hawaiian Florilegium, pp. 92–93, pl. 1996.

Haec species a *P. tripartita* var. *mollissima* (Kunth) Holm-Nielsen & P. Jørgensen sepalis et petalis longioribus perpendicularibus vel reflexis; loculo nectarifero majore; stipulis minoribus acicularibus distinguitur.

Liana, stem cylindrical, bark fibrous; internodes 6–12 cm long; indument canescent, soft to the touch. Stipules acicular, auricular, and aristate, 4–7 × 2(–3) mm (1–3 mm long without the aristate apex), arista 3–4 mm long, early deciduous. Petioles 1.5–4 cm, slightly caniculate adaxially, canescent-ferruginous pubescent with 1 to 4 pairs of adaxial glands. Leaves trilobed, (7–)16(–29) cm wide; lobes ovate, acuminate; margin serrate, central lobe (5.5–)11(–16) × (2.5–)5(–8) cm, lateral lobes (5–)9(–16) × (2.3–)4(–7) cm; lamina moderately lustrous above, glabrescent or scarcely pubescent, trichomes mostly short, mixed with some very long; undersurface canescent-pubescent, the trichomes ferruginous along the nerves. Flowers axillary, solitary, pendent; peduncles 3–10 cm, canescent-pubescent; bracts 3–5 × 2–3 cm, united

halfway, margins entire, ovate, acuminate, nerves yellowish, reticulate venation visible, located 1 cm from hypanthium base; floral tube (including hypanthium) 6–8 × 0.7–1 cm, light green outside, whitish inside; nectar chamber semiglobose, 1.4–2 cm wide; operculum reflexed, margin recurved; annulus present; sepals and petals bright pink to light pink, generally 64D or 75A in the *R.H.S. Colour Chart* (1966), one white sport seen, opening perpendicular at anthesis, then becoming reflexed later in the day or on the second day; sepals 4.5–6 × 1.2–2.5 cm, oblong, aristate subterminally, awn 3–4 mm; petals 3–6 mm shorter than the sepals; floral tube/sepal length ratio 1.3–1.6; corona reduced to a tuberculate ring at mouth of floral tube, white with purple base; androgynophore 7–10 cm, white; free staminal filaments 2 cm, white; anthers yellow; ovary fusiform, green, pubescent; styles white, stigmas green. Fruit 10–14 × 3.5–4.5 cm, fusiform; young fruits canescent, the pericarp dark green with white dots except along the main vascular bundles, the dried styles persistent; during maturation dots disappearing and fruit turning yellow to orange yellow. Seeds asymmetrical, reddish brown when dry, reticulate, acute, cordate; arils orange, sweet, and aromatic.

Figure 2 shows the sites where *P. tarminiana* has been observed or collected in the Andes. Table 1 presents a comparison of *P. tarminiana* with two other similar and common species of the subgenus *Tacsonia*. The most typical traits of *P. tarminiana* are the absent or very reduced pubescence on the upper side of the leaves, the minute stipules that are almost always deciduous, the flower with a smaller floral tube/sepal length ratio, as compared to other similar and common species such as *P. tripartita* (Jussieu) Poiret or *P. mixta*. It is further characterized by reflexed light pink petals, a nectar chamber that is much wider than the floral tube, and a fusiform fruit with small whitish dots that are evenly distributed on the pericarp before maturity, except on the six main vascular strands. In comparison, the other widely cultivated banana passion fruit, *P. tripartita* var. *mollissima*, shows a marked pubescence on both leaf sides, persistent and larger stipules, a bell-shaped corolla, a longer floral tube, and shorter sepals and petals. The fruit of the cultigen *P. tripartita* var. *mollissima* is oblong with round extremities, and uniformly green before maturity (however, *P. tripartita* var. *tripartita* may also show whitish dots on the immature fruit). When both cultigens can be compared in the same orchard, *P. tripartita* var. *mollissima* shows much darker foliage, magenta flowers, and pale yellow mature fruits. The fruits of *P. tarminiana* are of a deeper yellow to orange color, and their pulp is less aromatic and tart. These differences in shape and color make them easy to recognize.

According to the botanical keys of Colombia and Ecuador, *P. tarminiana* would key out to species with broadly ovate-reniform or auriculate and denticulate stipules and pendent peduncles, near *P. cumbalensis* and *P. tripartita* (*P. mollissima* in Escobar, 1988). Our new species can easily be distinguished from either of these species by the size and duration of the stipules and the widening of the nectar chamber. Leaf pubescence is not useful to discriminate *P. tarminiana*, as both *P. cumbalensis* and *P. tripartita* show variation for this trait. In Colombia, because *P. tarminiana* had not been described as a distinct species, and because it is sometimes named "curuba quiteña" or "curuba ecuatoriana," some researchers confused it with *P. tripartita* var. *tripartita*, from Ecuador. This confusion is sometimes found in the "gray literature" (research reports and student theses, e.g., Sañudo & Jurado, 1990).

Confusion with *P. tripartita* var. *mollissima* or with supposed hybrids is frequent in the horticultural, weed science, and fruit culture literature. Pictures of flowers and fruits of *P. tarminiana* are frequently presented as those of *P. tripartita* var. *mollissima* (e.g., Vanderplank, 1996; Ulmer & Ulmer, 1997; Wagner et al., 1999). Sorting out these two species is of special concern to biological control of invasive species programs, where host specificity determines which controls may be used and may have broad implications for conservation policy (see Waage et al., 1981; Chacón & Hernandez, 1981).

As commonly observed in the subgenus *Tacsonia*, *P. tarminiana* hybridizes easily with other species of the subgenus. The hybrids with *P. mollissima* and *P. mixta* are fertile and show intermediate phenotypes (Coppen, pers. obs.). Hybrid seeds have also been obtained with *P. cumbalensis* (J. F. Restrepo, pers. comm.).

Passiflora tarminiana is adapted to a wide range of elevations as compared to other species of subgenus *Tacsonia* growing at tropical latitudes. It may be cultivated from about 2000 m up to more than 3000 m. In comparison, *P. tripartita* var. *mollissima* is not well adapted under 2400 m. As in *P. tripartita* var. *mollissima*, the fruits of *P. tarminiana* grow larger at higher elevations. *Passiflora tarminiana* seems to be more resistant to fungi. La Rosa (1984) reported widespread lesions of *Alternaria* and *Colletotrichum* fungi on the fruits in Hawai'i, but we have never observed conidia on its leaves or a sig-

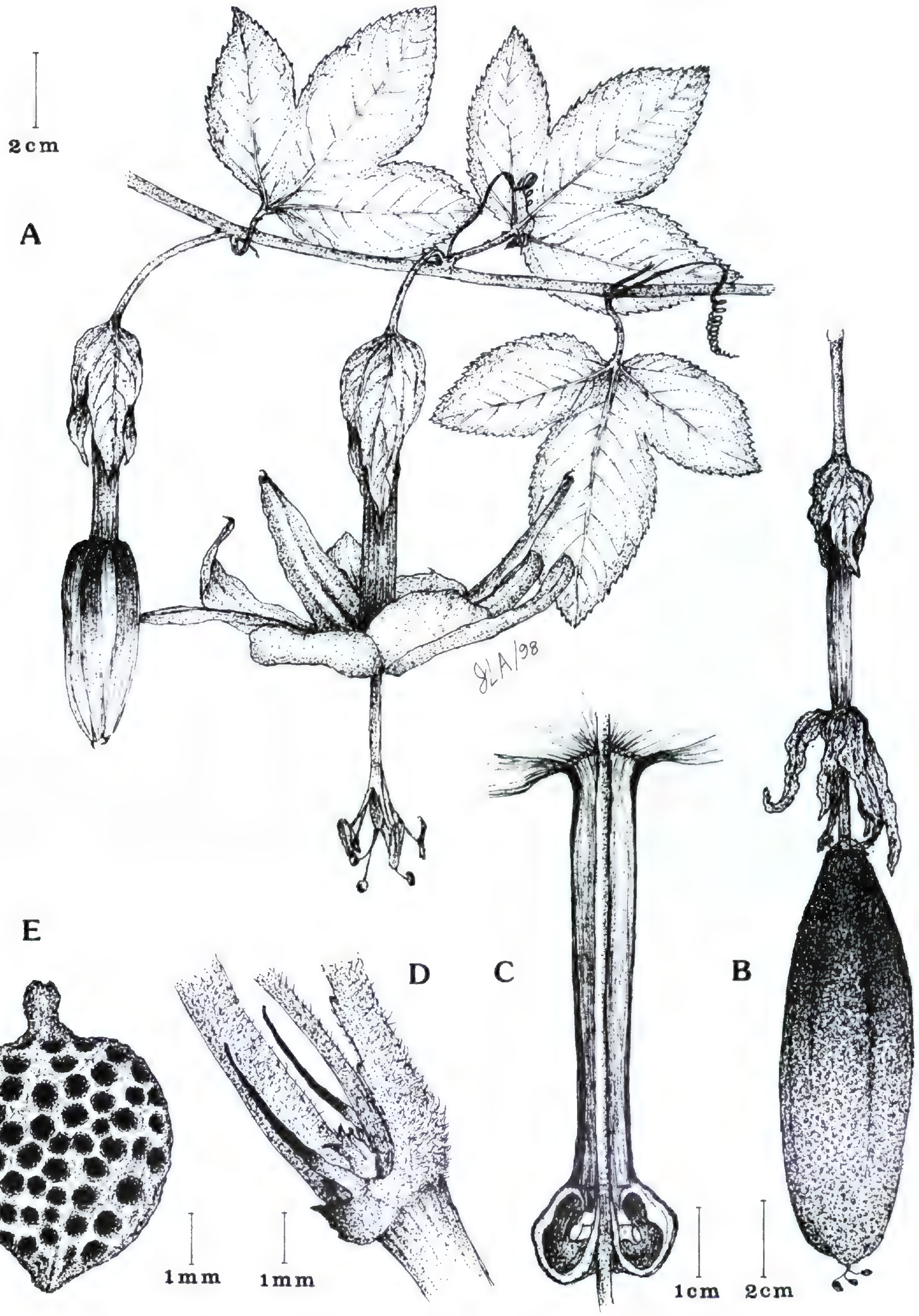


Figure 1. *Passiflora tarminiana* Coppens & Barney. —A. Habit with bud and flower at anthesis. —B. Fruit. —C. Longitudinal section of hypanthium and floral tube showing nectary chamber, operculum, and reduced corona. —D. Node showing stipules. —E. Seed. All drawn from the plants of the type collection.

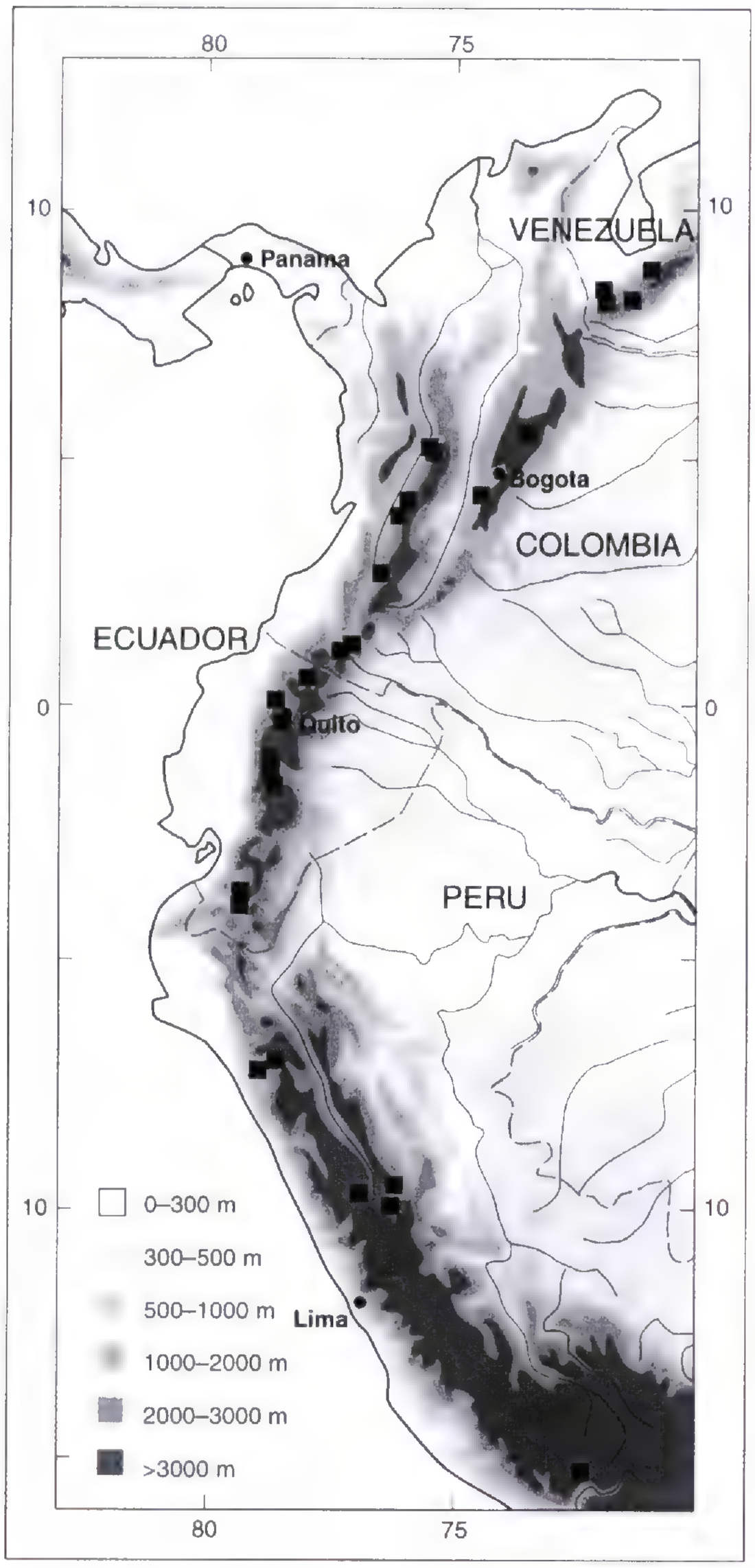


Figure 2. Distribution of *Passiflora tarminiana* in northwestern South America. Squares represent collections.

nificant number of anthracnose necrotic spots on its fruits in South America. On the contrary, the pericarp of *P. tripartita* var. *mollissima* fruits is often affected by anthracnosis, which reduces its market value despite its superior taste. In Venezuela, *P. tripartita* var. *mollissima* has shown high susceptibility to fusarium blight while *P. tarminiana* appeared tolerant or resistant (E. González, pers. comm.). The adaptive potential and rustic nature of *P. tarminiana* have probably been key factors in its conquest of new habitats in New Zealand and Hawai'i where it is reported as a noxious weed (La Rosa, 1984).

Villacis et al. (1998) studied morphological variation in an Ecuadorian field collection including the most common species of subgenus *Tacsonia*. The cluster analyses based on both quantitative and qualitative morphological data clearly separated accessions of *P. tarminiana* from the other species. *Passiflora tarminiana* appeared closer to *P. tripartita* var. *mollissima* and *P. mixta* than to *P. cumbalensis* and *P. pinnatistipula* Cavanilles. Similarly, using six isozyme systems, Segura et al. (1998) showed that *P. tarminiana* is clearly separated from *P. tripartita* var. *mollissima*, *P. mixta*, and *P. cumbalensis*, while *P. tripartita* var. *mollissima* and *P. mixta* could not be clearly distinguished from each other. In a study by Fajardo et al. (1998) with RAPD markers on a sample of 52 plants from 7 subgenera and 14 species of passifloras, 8 plants of *P. tripartita* var. *mollissima* and 5 plants of the species here described (identified in the work as *Passiflora* sp. "india") formed two different subclusters within the subgenus *Tacsonia*. Three of these five plants of *P. tarminiana* produced the same cpDNA RFLP pattern, distinct from that obtained on cpDNA from *P. tripartita* var. *mollissima* (Sánchez et al., 1999).

The exact geographical origin of the new species is obscure. Throughout its range in South America, its situation is similar to that seen in *P. tripartita* var. *mollisima*: plants are nearly always found cultivated, escaped from cultivation, persistent near human habitation, or at least not far from orchards and roads. Despite numerous years in the field, the senior author has never found a specimen coming from a well-preserved forest or subparamo. Even in disturbed areas, we have not seen the new species forming populations similar to those seen in *P. mixta*. Additional studies should be directed to the southern part of the Andes: the isozyme data for *P. tarminiana* (Segura et al., 1998) show a wider diversity in Ecuador than Colombia or Venezuela, and herbarium specimens from Peru seem slightly more morphologically variable.

Passiflora tarminiana has been introduced into numerous cool tropical and tropical montane areas other than its original Andean range, in some cases becoming an invasive weed. Our examination of exsiccatae documents its spread to California by 1907, to Hawai'i by 1921 (La Rosa, 1984), to Mexico by 1936, to Ethiopia by 1967, to New Guinea by 1972, and to Zimbabwe by 1981. It recently has been introduced to the French island of La Réunion at elevations over 700 m (C. Lavigne, pers. comm.).

Most of the paratypes cited below are in small herbaria not registered with *Index Herbariorum*, and their abbreviations are italicized to distinguish them from approved herbarium acronyms. These abbreviations, *INIA*, *INIAP*, *IPGRI*, and *CIRAD-*

Figure 3. Color photos of the type collection plants, *Coppens IPGRI-AM 72*.—A. Habit of flowers, buds, and immature fruits. —B. Longitudinal section of flower showing interior of floral tube and nectary chamber; extra flap of tissue seen on left wall of nectary chamber is an artifact from sectioning. Bracts have been separated for clarity. —C. Shoot tip showing underside of leaves and distally valvate bracts completely enclosing young buds. —D. Mature fruits, one sectioned to show arils and seeds.

FLHOR/IPGRI, correspond to the following institutions: *INIA*—Instituto Nacional de Investigación Agraria, Perú, Casilla 2791, Lima 1, Peru; *INIAP*—Instituto Nacional de Investigaciones Agropecuarias, Ecuador, C.P. 17-01-340, Quito, Ecuador; *IPGRI*—International Plant Genetic Resources Institute, IPGRI-AM, oficina para las Americas c/o CIAT, A.A. 6713, Cali, Colombia; *CIRAD-FLHOR/IPGRI*—field germplasm collections in Tenerife, Colombia, maintained by CIRAD-FLHOR/IPGRI Project for Neotropical Fruits, address above.

Paratypes. COLOMBIA. **Cauca:** Silvia, *Barney IPGRI-AM-14* (*IPGRI*). **Valle del Cauca:** Barragán, 4°01.52′N, 75°53.54′W, 2900 m, *Coppens & S. Segura IPGRI-AM-3* (*IPGRI*); Tenerife (municipio El Cerrito), under cultivation, 2200–2600 m, 3°43.189′N, 76°04.482′W, same plants as type, *Coppens & Barney IPGRI-AM 2* (*IPGRI*, MO). ECUADOR. **Carchi:** S of Tulcán, 0°30.52′N, 77°54.05′W, 2690 m, *Coppens & Barney IPGRI-AM-13* (*IPGRI*). **Chimborazo:** Volcán Chimborazo, *Barney IPGRI-AM-8* (*IPGRI*); Riobamba, Químiag, 2650 m, *C. Tapia & J. Velásquez CS-070* (*INIAP*). **Loja:** Santiago, 3°47.38′S, 79°17.38′W, 2450 m, *Coppens IPGRI-AM-10* (*IPGRI*); Saraguro, San Lucas, 2550 m, *C. Tapia & E. Morillo CTEM-040* (*INIAP*). **Pichincha:** cultivada, Parroquia Calacali, Reserva Geobotánica Pululahua, 0°05′N, 78°30′W, *Cerón & Cerón 2740* (MO); 0°22′S, 78°25′W, 2650 m, *Coppens & Barney IPGRI-AM-12* (*IPGRI*); Unchibamba, S of Quito, 1°07.85′S, 78°35.32′W, 2610 m, *Coppens & Barney IPGRI-AM-11* (*IPGRI*); Rumiñahui, Iasa, 0°22′S, 78°25′W, 2650 m, *N. Mazón & B. Elizalde NMO-038* (*INIAP*). **Tungurahua:** Ambato, 1°22.02′S, 78°36.21′W, 2500 m, *Barney IPGRI-AM-9* (*IPGRI*); Baños, 2680 m, *Coppens IPGRI-AM-4* (*IPGRI*). PERU. **Arequipa:** Tuhuana, 15°39′06″S, 72°28′09″W, 2545 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 230* (*INIA*). **Cajamarca:** Barrio Santa Elena, 7°17′51″S, 78°51′56″W, 2730 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 170* (*INIA*); alrededores de Guzmango, Prov. Contumazá, 2600–2700 m, *Sagástegui A. 122* (US). **Huánuco:** Chinchao, 9°72′72″S, 76°09′68″W, 2650 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 101* (*INIA*), 2480 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 104* (*INIA*); Soldado Ucro, 9°80′90″S, 76°80′00″W, 3200 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 113* (*INIA*); Conchamarca, 10°03′99″S, 76°20′35″W, 2490 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 116* (*INIA*); La Libertad-Ting, 10°01′56″S, 76°17′00″W, 2820 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 118* (*INIA*); Quiulacocha, 10°01′56″S, 76°17′00″W, 2820 m, *Ll. Rios, J. Medina & L. López INIA-PRONARGEB 120* (*INIA*). VENEZUELA. **Mérida:** Mucuruba, 8°09.46′N, 71°20′W, 2000 m, *E. González & Barney IPGRI-AM-6* (*IPGRI*). **Táchira:** Betania,Villa Paez, 7°31.70′N, 72°26′W, 2000 m, *E. González & Barney IPGRI-AM-5* (*IPGRI*); Pueblo Hondo, 8°15.19′N, 71°53.07′W, 2500 m, *E. González & Barney IPGRI-AM-7* (*IPGRI*).

Representative specimens. ETHIOPIA. Alemaya, cultivated, *Westphal & Westphal-Stevels 494* (MO). MEXICO. **Distrito Federal:** cultivated at El Rosario, *MacDaniels 635* (BH). **Michoacán:** desv. a San José del Rincón carr. Angangeo–Villa Victoria, *Soto & Ramírez 1496* (MEXU, MO). **Morelos:** Mpio. Huitzilac, *H. Hernández 16* (MEXU); Mpio. Huitzilac, 1.2 km de la Carr. Federal Cuernavaca–México, D.F., rumbo a Zempoala, *Luna C. 21* (MEXU, MO). NEW ZEALAND. **North Island:** Mount Albert, *Astridge* (AK-*219103*); Wellington, *Brownsey* (AK-*152731*); Titirangi, *Cameron* (AK-*221386*); Grafton Gully, *Cameron* (AK-*221519*); Waiheke Island, *Cameron 7524* (AK-*229217*); Swanson, *Cameron 9458* (AK-*236385*); Paihia, *Cumber* (AK-*116173*); Mount Albert, *Dingley* (AK-*122719*); Palmerston, *Esler* (AK-*173113*); Mount Albert, *Esler* (AK-*219104*), *Esler* (AK-*219109*); Kerikeri, *Esler* (AK-*219107*); Wood Bay, *Esler* (AK-*219108*); between Nelson City and Whakapuaka, *Healy 74/80* (MO); Waitemata, *Mackinder* (AK-*162676*); Tutukaka and Matapouri, *Newfield* (AK-*212296*); Epsom, *J. Reid* (AK-*116084*); Motuihe, *Sikes* (AK-*220536*); Buller, Karamea, near Karamea, *Sykes 10/85* (MO); Hokianga, *Wright 912* (AK-*138965*); Waitemata, *Wright 1657* (AK-*140997*); Mount Albert, *B. Young* (AK-*114204*), *B. Young* (AK-*114205*), *B. Young* (AK-*116172*), *B. Young* (AK-*117558*); Titirangi, *B. Young* (AK-*116171*), *B. Young* (AK-*117563*); Otahuhu, *G. Young* (AK-*116164*). **South Island:** Port Hills, *Sikes* (AK-*225281*); Punakaiki, *B. Young* (AK-*117584*), *B. Young* (AK-*221387*). PANAMA. **Chiriquí:** carr. hacia la cima del Volcán Barú, *Montenegro 1630* (MO). PAPUA NEW GUINEA. **New Guinea:** Eastern Highlands, Mount Wilhelm near Iwam Pass, *Takeuchi 5898* (MO). U.S.A. **California:** cultivated "in Southern California," *Boughton 242* (US); Golden Gate Park, San Francisco, *Wight 1806* (MO). **Hawaii:** Hwy. 550 along Waimea Canyon, mile 14 near NASA tracking station, *Croat 44833* (MO); Kaua'i, rd. to Kumuwela Lookout, *Crosby & Anderson 1496* (DUKE); Hawai'i, Muana Kea, *Degener et al. 20354* (MO); Kaua'i, near Kokee Ranger Station, *Degener & Degener 35181* (MO); Hawai'i, Puna, Hawai'i Volcano National Park, *Degener & Degener 35183* (MO); Kaua'i, *Henrickson 4034* (NCU); Hawai'i, Puna district, land of Olaa, *D. Horbst* (MYF-*459*); Kaua'i, Waimea District, Na Pali-Kona Forest Reserve, Makaha Valley, *Lorence 5221* (MO); Kaua'i, Pu'u Hinahina Lookout, Waimea Canyon, *Thorne & Zupan 10153* (MO); Hawai'i, Muana Kea road by Douglass Monument, *Trujillo s.n.* (MO); Hawai'i, North Kona, Puuwaawaa, *Webster & Wilbur 1853* (DUKE). ZIMBABWE. Distr. Inyanga, Inyanga Downs, naturalized in Kloof, near sawmill, *Geddes s.n.* (MO).

Numerous germplasm collections of the new species from five departments in Colombia and one in Ecuador are presently maintained at *CIRAD-FLHOR/IPGRI*.

Acknowledgments. This research has been partly funded by Colciencias through the project 1203-12-097-98: "conservación y utilización de los recursos genéticos de pasifloras." The authors thank S. Tillett (MYF), Elide Gonzalez (*FONAIAP*), Jaime Estrella and Nelson Mazón (*INIAP*), Jorge Vega (Universidad Técnica de Ambato), Llermé Ríos (*INIA*), and C. Lavigne (*CIRAD-FLHOR*) for helping in collecting or by providing herbarium material, Luigi Guarino (*IPGRI*) for mapping the distribution of the species, and Sophie Primot and Vincent Rioux for gathering morphological data for

Table 1. The botanical illustration was executed by Jairo Larahondo Aguilar.

Literature Cited

A. A. A. (Asistencia Agroempresarial Agribusiness). 1992. Manual técnico del taxo. Editorial Ecuador, Quito.

Campos, T. C. 1992. El cultivo de la curuba (*Passiflora mollissima* (HBK) Bailey) en Colombia. Acta Hort. 310: 215–229.

Chacón, P. & M. R. de Hernandez. 1981 [1982]. Immature stages of *Odonna passiflorae* Clarke (Lepidoptera: Oecophoridae): Biology and morphology. J. Res. Lepidoptera 20: 43–45.

Escobar, L. K. 1980. Interrelationships of the Edible Species of *Passiflora* Centering around *Passiflora mollissima* (H.B.K.) Bailey subgenus *Tacsonia*. Ph.D. Thesis, University of Texas, Austin.

———. 1988. Monografía No. 10. Passifloraceae. *Passiflora*. Subgéneros: *Tacsonia, Rathea, Manicata & Distephana*. Universidad Nacional de Colombia, Bogotá.

Fajardo, D., F. Angel, M. Grum, J. Tohme, M. Lobo, W. M. Roca & I. Sánchez. 1998. Genetic variation analysis of the genus *Passiflora* L. using RAPD markers. Euphytica 101: 341–347.

Green, P. S. 1972. *Passiflora* in Australasia and the Pacific. Kew Bull. 26: 539–558.

Grierson, M. & P. S. Green. 1996. A Hawaiian Florilegium: Botanical Portraits from Paradise. National Tropical Botanical Garden, Lawai, Kaua'i, Hawai'i.

Holmgren, P. K., N. H. Holmgren & L. C. Barnett (Editors). 1990. Index Herbariorum Part I: The Herbaria of the World. Regnum Veg. 120.

Holm-Nielsen, L. B., P. M. Jørgensen & J. E. Lawesson. 1988. 126. Passifloraceae. No. 31. Flora of Ecuador. Berlings, Arlöv, Copenhagen, Denmark.

Jaramillo, A. 1957. Primeros resultados de un ensayo sobre el cultivo de la curuba (*Passiflora* spp.). Agricultura Tropical 13(5): 301–308.

La Rosa, A. M. 1984. The biology and ecology of *Passiflora mollissima* in Hawaii. Cooperative National Park Resources Studies Unit. Technical Report 50.

Pérez Arbeláez, E. 1978. Plantas utiles de Colombia. Litografía Arco, Bogotá, Colombia.

R.H.S. Colour Chart. 1966. Royal Horticultural Society, London.

Sánchez, I., F. Angel, M. Grum, M. C. Duque, M. Lobo, J. Tohme & W. Roca. 1999. Variability of chloroplast DNA in the genus *Passiflora* L. Euphytica 106: 15–26.

Sañudo, B. & D. Jurado. 1990. Búsqueda de fuentes de resistencia a enfermedades fungosas de la curuba en Nariño. Ascolfi informa 16(1): 3.

Segura, S. D., G. Coppens d'Eeckenbrugge & P. Ollitrault. 1998. Isozyme variation in five species of *Passiflora* subgenus *Tacsonia* and *Passiflora manicata*. Proc. Interamerican Soc. Trop. Hort. 42: 260–266.

Ulmer, T. & B. Ulmer. 1997. Passionsblumen: Eine faszinierende Gattung. Pp. 5–384. Laupenmúhlen Druck, Witten.

Vanderplank, J. 1996. Passion Flowers. Cassel, London.

Villacis, L. A., J. Vega, M. Grum & G. Coppens d'Eeckenbrugge. 1998. Morphological characterization of Andean passifloras (*Passiflora* spp.) from Ecuador. Pl. Genet. Res. Newsl. 115: 51–55.

Waage, J. K., J. T. Smiley & L. E. Gilbert. 1981. The *Passiflora* problem in Hawaii: Prospects and problems of controlling the forest weed *P. mollissima* [Passifloraceae] with Heliconiine butterflies. Entomophaga 26: 275–284.

Wagner, W. L., D. A. Herbst & S. H. Sohmer. 1999. Manual of the Flowering Plants of Hawai'i. Rev. ed., vol. 2: 989–1919. Univ. Hawai'i Press/ Bishop Museum Press, Honolulu.

Young, B. R. 1970. Identification of passionflowers in New Zealand (Dicotyledones: Passifloraceae). Rec. Auckland Inst. Mus. 7: 143–169.

A New Species of *Commelina* (Commelinaceae) from Tanzania

Robert B. Faden
Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A.

Mac H. Alford
Department of Biological Sciences, Mississippi College, Clinton, Mississippi 39058, U.S.A.
Current address: L. H. Bailey Hortorium, 462 Mann Library, Cornell University, Ithaca, New York 14853-4301, U.S.A.

ABSTRACT. *Commelina polhillii* Faden & Alford, a new annual species of *Commelina* with buff-orange flowers, is described from Tanzania. It differs from the similar *C. subulata* primarily in seed morphology. However, staminode shape, the presence of basal lobes on the medial anther connective, and differences in spathe pubescence also serve to varying extent to distinguish the two taxa. Leaf anatomy reveals one major difference but primarily helps to unite the two species with a group of approximately seven other species. A preliminary chromosome count, $2n$ = ca. 30, is recorded.

Key words: *Commelina*, Commelinaceae, Tanzania.

Herbarium studies at the Royal Botanic Gardens, Kew, over the past several years by the senior author have confirmed the richness of the flora of Tropical East Africa (Kenya, Uganda, and Tanzania) in species of Commelinaceae (Faden, 1994). He has described a number of new species (Faden, 1984, 1991, 1994) and recognized other undescribed species. Fieldwork in Tanzania in 1996 afforded the senior author the opportunity to collect some of the unnamed species. The availability of living material, grown from field-collected seeds, and a summer internship by the junior author have enabled the completion of the study of one of these new species.

Commelina polhillii Faden & Alford, sp. nov. TYPE: Tanzania. Iringa District: 9 km SW of Iringa along the Mbeya Road, 7°49′23″S, 35°38′37″E, murram pit in drying sand among grass, locally common, 10 June 1996, *R. B. Faden, S. M. Phillips, A. M. Muasya & E. Macha 96/94* (holotype, US3342557; isotypes, K, NHT). Figures 1, 2.

Herbae annuae ad 7–20(45) cm longas; folia lamina lineari ad lineari-lanceolatam, conduplicata, 1.0–8.4 (–11.4) × 0.3–0.7 cm; spathae pedunculo 0.6–5.0 mm longo, solitariae, 3.9–11.0(–16.5) mm longae, 2.6–6.0 mm altae, paginis glabris, marginibus ciliatis; cincinnus superior vestigialis vel nullus, cincinnus inferior 3–4 flores efferens; flores armeniaci, 7–10 mm lati; capsulae 2.5–4.0 × 1.5–2.7 mm, triloculares, trivalves, loculo dorsali dehiscenti, monospermo, loculis ventralibus 2-spermis; semina 0.85–1.4 mm diametro cum fovea rotunda profunda dorsali, testa brunnea farinosa. Differt a *C. subulata* seminibus.

Annual with erect or ascending to decumbent shoots 7–20(45) cm long, sometimes rooting at the lower nodes; roots thin, fibrous; stems slightly flattened on one side, often maroon or with maroon stripes, especially on older parts or near the nodes; internodes to 10 cm long, glabrous except for a line of pubescence continuous with that of the distal sheath. Leaves with sheaths 3–7 mm long, usually split to the base, sometimes purple-veined, with a line of hairs along the split edge, otherwise glabrous, lamina sessile, conduplicate, often falcate, linear to linear-lanceolate, 1.0–8.4(–11.4) × 0.3–0.7 cm, apex acuminate, margins often ciliate toward the lamina base, rarely ciliate distally, scabrous apically, surfaces glabrous, midrib moderately prominent on abaxial surface. Spathes solitary; peduncles 0.6–5.0 mm long, with a line of pubescence; spathes slightly to not at all falcate, 3.9–11.0(–16.5) mm long, 2.6–6.0 mm high, apex acute to acuminate, base cordate to deeply cordate or occasionally truncate to hastate, margins free, ciliate, with hairs decreasing in length toward the spathe apex, surfaces entirely glabrous, green (rarely the veins faintly purple), somewhat paler basally; upper cincinnus absent or vestigial, lower cincinnus 3- or 4-flowered, its peduncle 2.5–3 mm long. Flowers mostly perfect, occasionally staminate, 7–10 mm wide; pedicels 1.4–3.9 mm long; sepals 3, translucent, tinged pink apically, upper sepal cup-shaped, ovate, 1.4–1.9 × 1.1–1.5 mm, paired sepals basally fused for about one-half to two-thirds

Figure 1. *Commelina polhillii* Faden & Alford. —A. Habit. —B. Spathe. —C. Bisexual flower, front view. —D. Bisexual flower, with petals reflexed, front/side view. —E. Bisexual flower, with front lateral petal and lateral sepal removed, side view. —F. Medial stamen, top view. —G. Medial stamen, side view. All from *Faden, Phillips, Muasya & Macha 96/94B* (ex cultivation Smithsonian Institution).

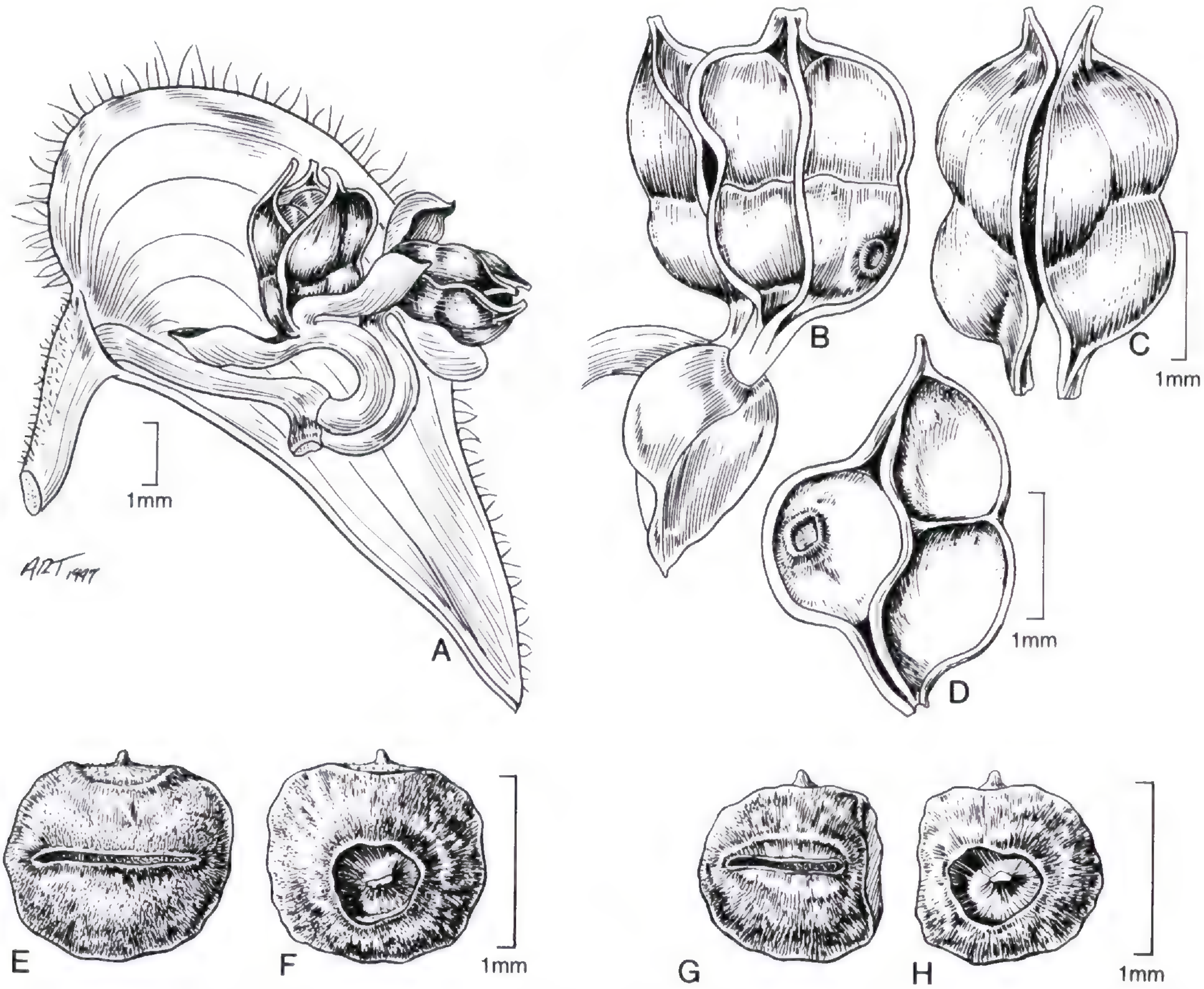


Figure 2. *Commelina polhillii.*—A. Spathe, with two mature, dehiscing fruits, front half of spathe removed. —B. Dehiscing capsule, lateral view. —C. Dehiscing capsule, dorsal view, showing middorsal dehiscence. —D. Dorsilateral capsule valve, internal view. —E. Dorsal locule seed, ventral view. —F. Dorsal locule seed, dorsal view. —G. Ventral locule seed, ventral view. —H. Ventral locule seed, dorsal view. All from *Faden, Phillips, Muasya & Macha 96/94B* (ex cultivation Smithsonian Institution).

of their length, each sepal broadly elliptic, 1.4–2.1 × 1.5–2.2 mm; paired petals 3.5–4.8 × 2.5–4 mm, buff-orange (168D in *R.H.S. Colour Chart* (1995)), limb reniform and often reflexed, 2.5–3.3 × 2.5–4 mm, claw 1.2–2.0 mm long, concolorous with the limb, lower petal concolorous, transversely elliptic, 1.3–2.1 × 2.0–2.8 mm, with an apical tooth; staminodes 3, equal, filaments directed toward the front of the flower, 1.3–2.2 mm long, reddish, antherodes yellow, 6-lobed with minute pollen sacs, generally as wide as long, ca. 0.8 mm square; lateral stamens with filaments parallel or slightly divergent, 1.6–3.2 mm long, light pink, anthers ovate, 0.6–0.7 × 0.4–0.7 mm, sutures dark, pollen orange; medial stamen with filament 1.8–2.3 mm long, light pink, anther saddle-shaped, 0.8 × 0.8–1.0 mm, yellow, connective with two prominent, sterile basal lobes, pollen orange; ovary ovoid, 0.7–1.0 × 0.4–0.7 mm, light green, style 2.5–3.2 mm long, light pink becoming translucent apically, stigma capitate. Capsules trilocular, trivalved, 2.5–4.0 × 1.5–2.7 mm, apiculate; dorsal locule dehiscent, 1-seeded; ventral locules each 2-seeded. Seeds circular to slightly elliptic in outline, slightly dorsiventrally compressed, 0.85–1.4 mm diam., with a large, deep, central dorsal pit 0.3–0.65 mm diam. (the pit with a conical projection arising from its base but not emergent), testa dark brown, lightly covered throughout, including within the pit, by white farinose granules, sometimes also sparsely warty; embryotega concolorous with the testa, not very distinct, hilum shorter than the seed, linear, straight or curved, slightly raised.

Habitat. Woodland, murram ["a hard lateritic material associated with soils with impeded drainage in Africa and locally used as road metal," *Oxford English Dictionary*] pits, edge of cultivation, shallow soil on ironstone outcrop, sandy soil; ca. 1050–1500 m.

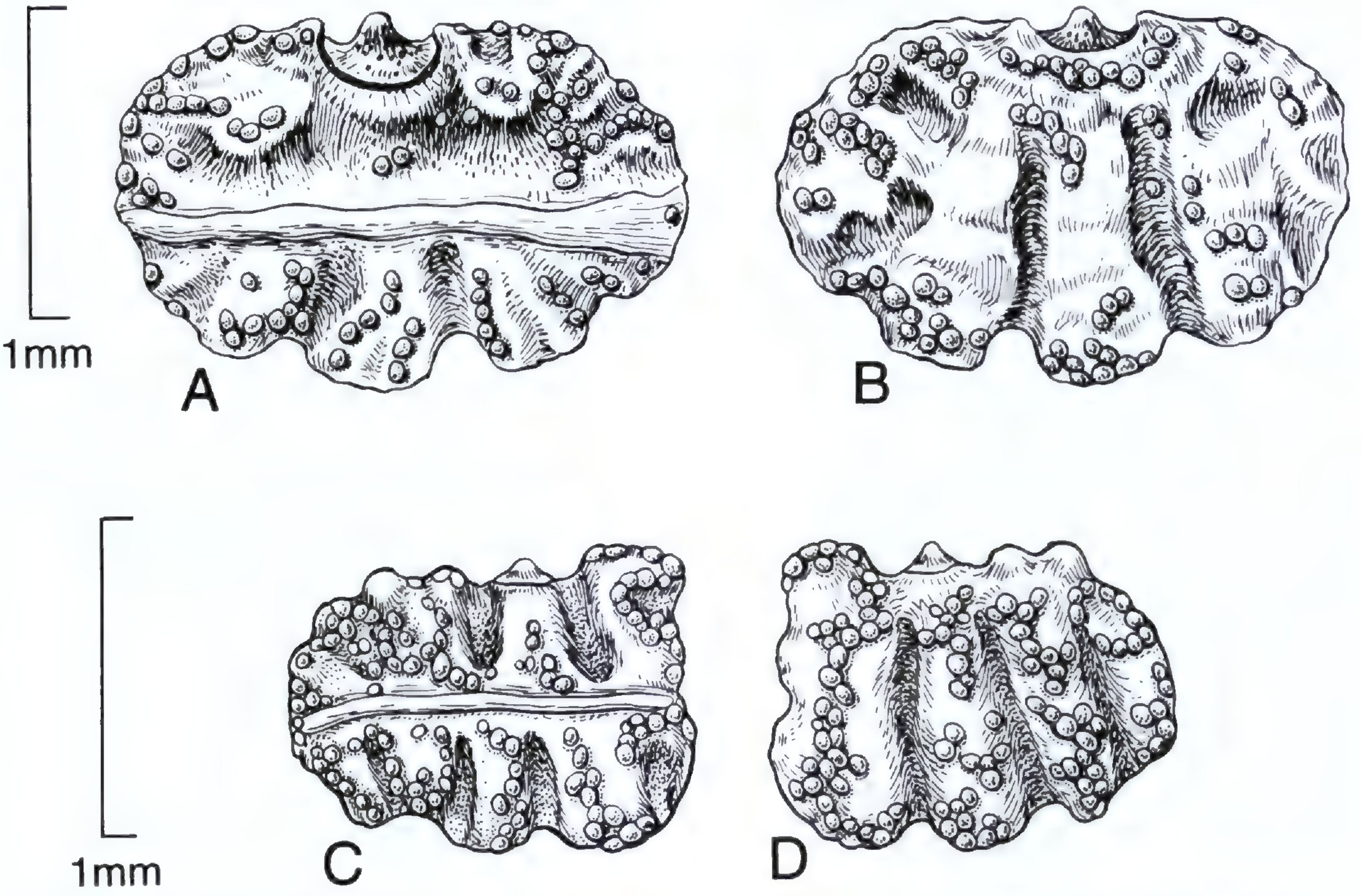


Figure 3. *Commelina subulata* Roth. —A. Dorsal locule seed, ventral view. —B. Dorsal locule seed, dorsal view. —C. Ventral locule seed, ventral view. —D. Ventral locule seed, dorsal view. All from *Faden, Phillips, Muasya & Macha 96/216* (from Tanzania).

Chromosome number. $2n$ = ca. 30.

Distribution. Known only from the Iringa and Mpanda Districts (flora districts T4, 7 of *Flora of Tropical East Africa* (Polhill, 1988)), Tanzania.

Commelina polhillii is morphologically very similar to the sympatric *C. subulata* Roth. (Both species were collected at the type locality of *C. polhillii.*) The seeds serve as the primary differentiating feature. The seeds of *C. polhillii* are round to slightly elliptic in outline (nearly isodiametric), with a single, central, round, deep dorsal pit, while those of *C. subulata* are elliptic (length/width ratio usually ca. 2:1) with 3–4 deep furrows separated by warty ridges radiately arranged on the dorsal surface (Figs. 2, 3).

The unusual seeds of *Polhill & Paulo 1375* were initially spotted by J. P. M. Brenan, who separated this specimen as a distinct species related to *C. purpurea* Rendle in the Kew herbarium. Our study has confirmed the importance of this seed type, has revealed additional collections with the same seeds, and has shown that the new species is more closely similar to the annual *C. subulata* than to the perennial *C. purpurea,* which is much larger in all of its parts.

The difficulty in finding additional characters to separate *C. polhillii* from *C. subulata* stems from the latter species' extremely wide distribution (throughout tropical Africa; also in Yemen and India) and associated great variability in spathe size, pubescence, and markings. The seeds, however, seem to be much less variable than the spathes. *Commelina subulata* has not been fully studied. In particular, the flowers are inadequately known, especially from forms with larger spathes.

Several characters in *C. subulata* are quite variable. The antherodes (staminode anthers) range from rectangular to U-shaped to broadly cruciform, whereas in *C. polhillii* they are squarely cruciform (Fig. 1C–E). The spathes of *C. subulata* are variable in size and can be completely glabrous, have glabrous surfaces and ciliate margins, or have the surfaces sparsely to densely pilose. The spathes can be entirely green or have prominently maroon veins.

In *C. polhillii* the spathes are typically small (≤ 11 mm long), with glabrous surfaces and ciliate margins. Usually the veins are completely green, but rarely they are faintly purple. Thus the spathes of *C. polhillii* are identical to a subset of specimens of *C. subulata.* Additional collections of *C. polhillii* might demonstrate a greater variability in spathe characters. However, based on our current knowledge, only 2 of the 13 collections of *C. subulata*

from Tanzania in the United States National Herbarium (US) fall within the range of spathe characters of *C. polhillii.*

The medial anther in *C. subulata* is also variable. In the liquid-preserved material that has been examined at K and US, in small-spathed plants (spathes ≤ 10 mm long), e.g., *Gillett 13558* (K spirit #2219), the medial stamen lacks sterile basal lobes. In the single large-spathed collection examined, *Bullock s.n.* (K spirit #4568), prominent sterile basal lobes were present on the medial anther. In *C. polhillii* the medial anther has distinct sterile basal lobes. It is uncertain whether this character is sufficiently constant to always separate *C. polhillii* flowers from those of similar-sized *C. subulata* plants.

Leaf anatomy lends some taxonomic help. *Commelina polhillii* has several rows of adaxial papillae near the margin and does not have extensive cellular differentiation below the vascular bundles on the abaxial surface. *Commelina subulata* lacks the rows of papillae and has very prominent, elongate (rectangular) cells under the vascular bundles on the abaxial surface. However, the small number of samples and even smaller number of populations represented make these data preliminary at best.

In cultivation it was observed that 25% of all flowers of *C. polhillii* were functionally male, with a reduced gynoecium. However, the cultivated plants were quite old when this observation was made, so this may be an artifact. In a pollinator exclusion experiment, 9 out of 10 bagged, bisexual flowers set fruit.

A preliminary chromosome count of $2n = 30$ was obtained for *C. polhillii,* using the method of Faden and Suda (1980). Two intact root tip cells of one plant yielded exact counts of $2n = 30$, but the two living plants became senescent and no further counts could be obtained.

Commelina polhillii and *C. subulata* belong to an unnamed, almost entirely African species group that is characterized by spathes with free margins, buff-orange flowers, the lower petal large and usually concolorous with the paired petals, and apiculate, trilocular, usually trivalved and five-seeded capsules. The species in this group, which is centered in Tropical East Africa, are mostly annuals of seasonally wet habitats. The recognized species, in addition to the above two, are *C. purpurea, C. lugardii* Bullock, *C. reptans* Brenan, *C. nyasensis* C. B. Clarke, *C. merkeri* K. Schumann, *C. trilobosperma* K. Schumann, and *C. arenicola* Faden, the last species, an endemic of Somalia, being the only species in the group to occur at low elevations and to have a bilocular capsule with an indehiscent dorsal locule.

Leaf morphology and anatomy have proven to be at least as distinctive of this species group as the reproductive characters listed above. The leaves are always linear to linear-lanceolate, with a symmetric base and conduplicate vernation (as opposed to supervolute or involute vernation, which are typical of other *Commelina* species). The transverse section of the lamina, as studied in *C. polhillii, C. subulata, C. lugardii, C. reptans, C. nyasensis,* and *C. merkeri,* shows two unique features for the genus: a continuous, one- to several-layered adaxial hypodermis and both adaxial and abaxial palisade layers. Some variation occurs between species, but not enough populations have been investigated to know whether the differences are diagnostic.

This species is named for Roger M. Polhill, whose collections of liquid-preserved flowers of East African Commelinaceae have greatly facilitated the study of this family.

Paratypes. TANZANIA. **Iringa:** Ruaha National Park, Magangwe Ranger Post, 1330 m, *Terminalia mollis-T. sericea-Combretum grandifolium-C. zeyheri-Dalbergiella nyassae-Julbernardia globiflora* woodland, 8 Mar. 1972, *Bjørnstad AB 1431A* (mixed collection with *Bjørnstad 1431B*: *C.? saxosa* De Wild.) (K); 9 km SW of Iringa along the Mbeya Road, E side of road, 7°49′23″S, 35°38′37″E, murram pit in drying sand among grass, 10 June 1996, cult. Smithsonian Institution, pressed 15 July 1997, *Faden, Phillips, Muasya & Macha 96/94A* (DAR, K, US); same locality and cultivation, pressed 29 July 1997, *Faden, Phillips, Muasya & Macha 96/94B* (EA, MO, US); Kalenga, 15 km SW of Iringa, 1435 m, wet sandy soil with some clay admixed, edge of cultivation, 7 Feb. 1962, *Polhill & Paulo 1375* (K); Ruaha National Park, Magangwe, *Brachystegia* woodland, 18 May 1968, *Renvoize 2241* (K). **Mpanda:** 10 km on Mpanda–Inyanga road, 6°22′S, 31°09′E, 1050 m, ironstone outcrop with shallow soil and *Brachystegia* woodland, 15 May 1997, *Bidgood, Sitoni, Vollesen & Whitehead 3972* (K, US).

Acknowledgments. This study was conducted as part of the 1997 Research Training Program at the National Museum of Natural History, Smithsonian Institution. We thank the Office of the Director, National Museum of National History, for providing financial support for the junior author; the Research Opportunities Fund, National Museum of Natural History, and the Royal Botanic Gardens, Kew, for funding the fieldwork to southern Tanzania in 1996 by the senior author; The American Society for the Royal Botanic Gardens Kew for financial support for herbarium studies at the Royal Botanic Gardens, Kew, by the senior author, in connection with the *Flora of Tropical East Africa*; Stanley Yankowski for providing laboratory assistance; Alice Tangerini for the drawings; and the Royal Botanic Gardens, Kew, for the loan of specimens.

Literature Cited

Faden, R. B. 1984. New taxa of *Aneilema* R. Br. (Commelinaceae) from southern and tropical East Africa. Bothalia. 15: 89–100.

———. 1991. The morphology and taxonomy of *Aneilema* R. Brown (Commelinaceae). Smithsonian Contr. Bot. 76: 1–166.

———. 1994. New species of *Commelina* (Commelinaceae) from the Flora of Tropical East Africa. Novon 4: 224–235.

——— & Y. Suda. 1980. Cytotaxonomy of Commelinaceae: Chromosome numbers of some African and Asiatic species. J. Linn. Soc., Bot. 81: 301–325.

Polhill, D. 1988. Flora of Tropical East Africa. Index of Collecting Localities. Royal Botanic Gardens, Kew.

R.H.S. Colour Chart. 1995. Royal Horticultural Society, London.

New Taxa of *Murdannia* (Commelinaceae) from Sri Lanka

Robert B. Faden

Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A.

ABSTRACT. Three new species and three infraspecific taxa of *Murdannia* are described from Sri Lanka. *Murdannia dimorphoides* Faden, with subsp. *dimorphoides* and subsp. *perennis* Faden, and *Murdannia audreyae* Faden are endemic to Sri Lanka. *Murdannia striatipetala* Faden also occurs in southern India. The new variety, *Murdannia spirata* var. *parviflora* Faden, is recognized as indigenous in Sri Lanka and naturalized in the southern United States (Florida). *Murdannia vaginata* var. *glabrisepala* Faden is described from Sri Lanka, but whether it occurs elsewhere is not firmly established.

Key words: Commelinaceae, *Murdannia*, Sri Lanka.

With about 50 species, *Murdannia* Royle is one of the largest genera of Commelinaceae. In the course of working on the family for the *Revised Handbook to the Flora of Ceylon* (Faden, 2000) I recognized 3 new species, among the 14 species of *Murdannia* in Sri Lanka, and several unnamed infraspecific taxa. Among the latter were 3 that were well enough defined to be worthy of formal description. The 3 new species, 1 new subspecies, and 2 new varieties are described below.

Murdannia dimorphoides Faden, sp. nov. TYPE: Sri Lanka. Anuradhapura: Wilpattu National Park, Waliella, 2 mi. [1.2 km] from park gate on road to Maradanmaduwa, ca. 8°20′N, 80°08′E, open sandy area with seepage, 7 Jan. 1977, *R. B. Faden & A. J. Faden 77/72* (holotype, US 2890395; isotypes, C, E, F, K, L, MO, P, PDA, US) Figure 1A–G.

Ad *M. dimorpham* (Dalzell) G. Brückner forma seminum similis; foliis angustioribus, cincinnis oppositis vel verticillatis et seminibus parvioribus hilo punctiformi vel oblongo differt. Herbae annuae vel perennes; inflorescentiae (1–)2–4 cincinnis plurifloris oppositis vel verticillatis compositae; flores dimorphi, petalis lilacinis vel caesiis nervatura haud fusciore, filis omnibus barbatis, staminibus 3, polline albo, staminodiis 3, anthera sterili bicolori; capsulae 3.5–4.5(–5) × 1.5–2 mm, loculis 3–4 spermis; semina uniseriata, (0.5–)0.6–1.2(–1.45) × 0.6–0.9 mm, pagina ventrali fovea grandi centrali.

Tufted annuals with thin fibrous roots, or perennials with repent shoots from the lower nodes, and stipitate, fusiform tubers from the base. Leaves strongly decrescent distally on the flowering shoot, sheaths 0.3–1 cm long, ciliate at the apex, lamina linear to lanceolate-oblong, 1.5–8(–11.5) cm long, 0.25–0.65 cm wide, apex acute to acuminate, base rounded to amplexicaul, both surfaces glabrous to sparsely pilose, margins often ciliate at the base, scabrous apically. Inflorescences terminal (and often axillary in the upper leaves), usually umbelliform, obovoid to ovoid, 1–4 cm long, 1–5 cm wide, glabrous, composed of (1–)2–4, ascending, opposite or whorled cincinni; peduncles 1.2–3(–4.7) cm long, glabrous; cincinni to 4.5 cm long and 12-flowered; bracteoles spaced 1–4(–5) mm apart, amplexicaul, not perfoliate. Flowers bisexual or male, (6.5–)8.5–14.5 mm wide; pedicels erect in fruit, (2.5–)3–7 mm long, glabrous; sepals lanceolate to lanceolate-oblong, lanceolate-elliptic, elliptic or ovate, 2.5–4.5(–5) × 1.2–2 mm; petals obovate-elliptic to obovate, elliptic, obovate-orbicular or ovate-elliptic, (3.6–)4–5.5 × (2.6–)3–4.6 mm, lilac to lavender, the veins not conspicuously darker; stamens 3, bending to one side of the flower, the style to the other in the bisexual flower, symmetrically arranged in the male flower; filaments 2.1–2.75 mm long, densely bearded below the middle with long, patent hairs, anthers elliptic to oblong-elliptic, (0.8–)1.1–1.35 × 0.5–0.75 mm, pollen white; staminodes 3, filaments 1.3–2 mm long, sparsely to densely bearded basally, antherodes 3-lobed, 0.5–1.1 × 0.5–0.95 mm, medial lobe white, lateral lobes creamy yellow; ovary oblong-elliptic, 1–1.3 × 0.5–0.65 mm, green, style 1.6–2.2 mm long, lilac to violet basally, stigma capitate, white. Capsules oblong-ellipsoid, 3.5–4.5(–5) ×1.5–2 mm, brown, glabrous. Seeds uniseriate, 3 to 4 per locule, ovate to rectangular or trapezoidal in outline, (0.5–)0.6–1.2(–1.45) × 0.6–0.9 mm, testa light brown to gray or orange-brown, lightly rugose or striate, occasionally smooth, with a large midventral pit with a central, transverse ridge, hilum punctiform to oblong, on one side of the midventral pit, embryotega semilateral or lateral.

Murdannia dimorphoides may be separated into two allopatric taxa, as follows:

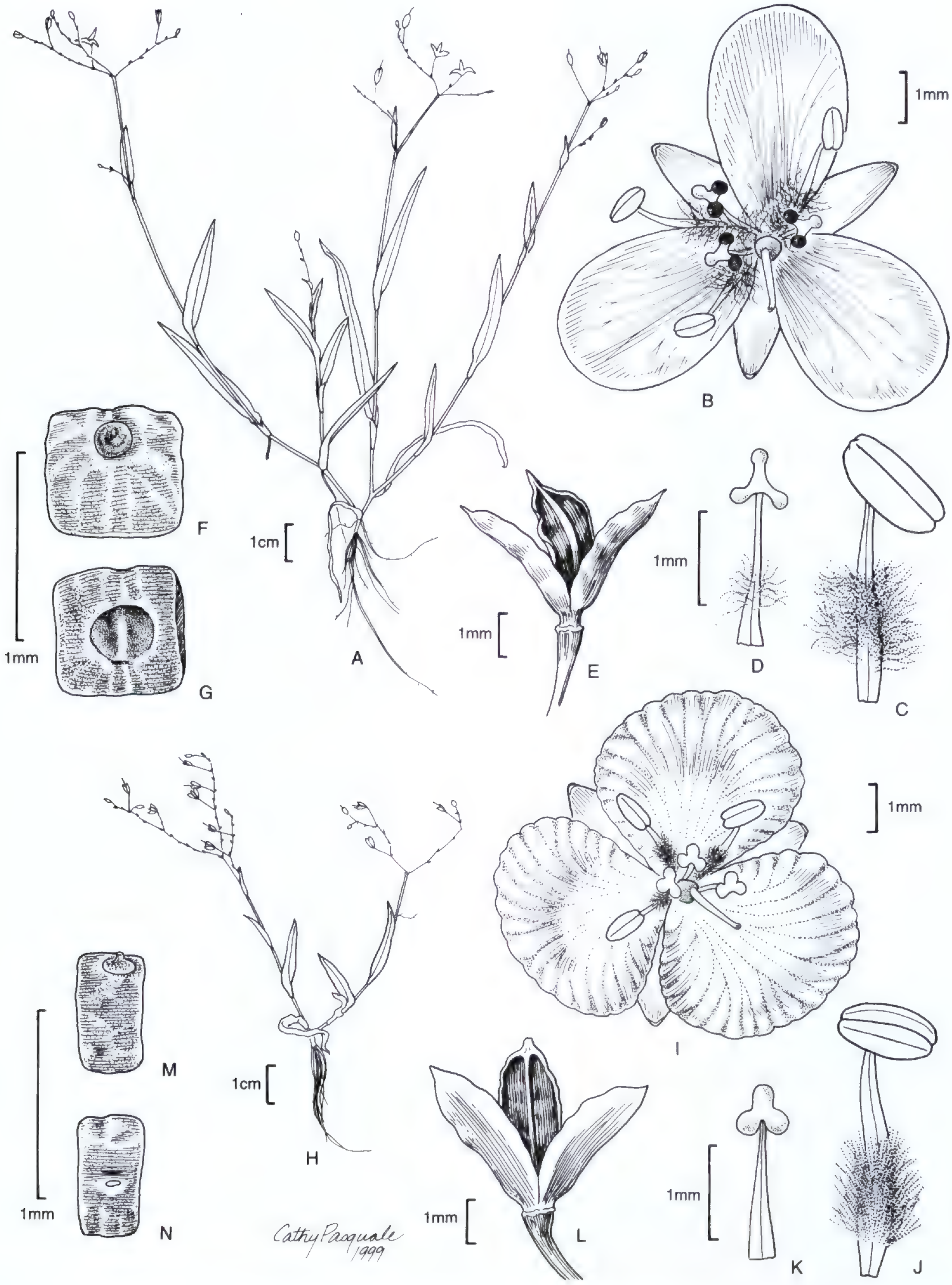


Figure 1. *Murdannia dimorphoides* Faden subsp. *dimorphoides* and *Murdannia striatipetala* Faden. A–G. *Murdannia dimorphoides* subsp. *dimorphoides.*—A. Habit. —B. Bisexual flower. —C. Stamen. —D. Staminode. —E. Capsule. —F. Seed, dorsal view. —G. Seed, ventral view. H–M. *Murdannia striatipetala.*—H. Habit. —I. Bisexual flower. —J. Stamen. —K. Staminode. —L. Capsule. —M. Seed, dorsal view. —N. Seed, ventral view. A is from *Faden & Faden 77/115* (US), B–G from *Faden & Faden 77/72,* H from *Faden & Faden 77/227* (US), and I–N from *Faden & Faden 77/202.* Drawings by Cathy Pasquale.

1a. Annuals lacking root tubers and repent stems . . . . . *M. dimorphoides* subsp. *dimorphoides*
1b. Perennials with root tubers and repent stems . . . . . *M. dimorphoides* subsp. *perennis*

Murdannia dimorphoides subsp. **dimorphoides**

Tufted, rarely unbranched, annuals with erect to ascending or decumbent shoots, (7–)15–30 cm tall; roots thin, fibrous; repent stems lacking; longest leaves usually linear-lanceolate, usually glabrous.

Distribution. Sri Lanka (endemic).

Habitat. Soil pockets in outcrops, seepage areas on granitic hills, open sandy areas with seepage, edges of woods, roadside ditches, marshy places; 0–300 m (rarely above 100 m); flowering December, January, flowers opening in the field 1045–1200 hr, fading 1330–1430 hr or later.

Paratypes. SRI LANKA. **Anuradhapura:** Andarawewa on Puttalam–Anuradhapura road, *Faden & Faden 77/97* (F, PDA, US); Wilpattu National Park, 0.4 km SE of Maradanmaduwa, *Fosberg et al. 50734* (US). **Jaffna:** Arukuveli, *Faden & Faden 77/144* (US), *Faden & Faden 77/205* (F, PDA, US); Pooneryn–Jaffna road, just before ferry crossing, *Faden & Faden 77/147* (F, PDA, US); 1.6 km from Pooneryn on Pooneryn–Paranthan road, *Faden & Faden 77/153* (F, PDA, US); Nallur on Pooneryn–Paranthan road, km 16, *Faden & Faden 77/218* (F, PDA, US); Puliyampokkana on Paranthan–Mullaittivu road, *Faden & Faden 77/231* (F, PDA, US); Punakari, Feb. 1890, s.lect. (PDA). **Mannar:** Medawachchiya–Mannar road, just before mile post 126/1, *Faden & Faden 77/115* (F, PDA, US); Nayorpalam, *Faden & Faden 77/122* (F, PDA, US). **Monaragela:** Kotaveharagala Rock, ca. 2 km E of Wellawaya, *Faden & Faden 76/606* (F, PDA, US); mile post 24/3 on Buttala–Kataragama road, *Faden & Faden 76/612* (F, PDA, US); mile post 32/4 on Kataragama–Buttala road, *Faden & Faden 76/635* (F, PDA, US). **Puttalam:** Colombo–Puttalam road, near mile post 72, *Wambeek et al. 2654* (US). **Vavuniya:** mile post 120/2 on Anuradhapura–Mannar road, *Faden & Faden 77/104* (F, PDA, US); Panikkankulam Forest Reserve, Panikkankulam, *Faden & Faden 77/197* (F, PDA, US); Mullaittivu, *Faden & Faden 77/245* (F, PDA, US).

Murdannia dimorphoides Faden subsp. **perennis** Faden, subsp. nov. TYPE: Sri Lanka. Polonnaruwa: Mannanpitiya–Maha Oya road, ESE of Gunner's Quoin, 7°51′N, 81°09′30″E, alt. ca. 30 m, sandy areas in grassland, 27 Jan. 1977, *R. B. Faden & A. J. Faden 77/268* (holotype, US 2890390; isotypes, C, E, F, K, L, MO, P, PDA, US).

Herbae perennes a subspecie *dimorphoide* surculis repentibus et radicibus tuberosis fusiformibus differt.

Perennials with erect to ascending, sparsely branched flowering shoots 8–20 cm tall, producing repent shoots from the lower nodes, roots with stipitate, fusiform tubers 1–1.5 cm long, 0.3–0.6 cm wide; longest leaves usually linear, pubescent.

Distribution. Sri Lanka (endemic).

Habitat. Open areas in grassland, sometimes near seasonal pools, growing in sandy soil and abandoned rice fields; alt. ca. 3–40 m; flowering January, February.

Paratypes. SRI LANKA. **Batticaloa:** Batticaloa–Trincomalee road, mile post 3/4, just after turnoff to Manresa Mission, *Faden & Faden 77/277* (F, PDA, US). **Badulla:** ca. 12.8 km E of Mahiyangana, *Koyama & Balakrishnan 13978* (NY, US). **Polonnaruwa:** Dalukana, *Faden & Faden 77/265* (F, PDA, US).

The new species has been named *Murdannia dimorphoides* because of its similarity to the Indian *M. dimorpha* (Dalzell) G. Brückner. Both species have similarly pitted seeds. The Indian species (see illustration in Wight (1853, fig. 2075, as "*Aneilema paniculata*")) has broader leaves, strictly alternate cincinni, and larger, darker brown seeds that are covered by raised, short ridges and warts, with a linear hilum. Based on cultivated material of *M. dimorpha* (*Saldanha 18790*), the sepals are more deeply cup-shaped and broader (2.25–2.5 mm) than those of *M. dimorphoides*, and the antherodes are entirely creamy yellow, not bicolored.

In Sri Lanka *Murdannia dimorphoides* most closely resembles *M. striatipetala* and some forms of *M. spirata* (see below). It differs from both by its often whorled cincinni (rare in the other species), bicolored antherodes, and especially by its seeds with a single, large, midventral pit divided by a transverse ridge. It further differs from *M. striatipetala* by its petals lacking contrasting, dark veins, its longer, patent hairs on the stamen filaments, and its bearded staminode filaments. The definite base of the plants further distinguishes *M. dimorphoides* from some forms of *M. spirata*.

Faden & Faden 76/635 from the Monaragala District resembles *Murdannia dimorphoides* subsp. *perennis* in its long, narrow, pubescent leaves, but it lacks repent stems and tubers. The plants are definitely annual, so they are intermediate between the two subspecies. The US sheet of *Koyama & Balakrishnan 13978* is similar to *Faden & Faden 76/635*. However, two plants on the NY sheet show repent stems and a third has tubers, so it certainly belongs to subspecies *perennis*. It is noteworthy that these two collections come from moister habitats ("marshy areas near small seasonal stream" and "abandoned rice field," respectively) than the other gatherings of subspecies *perennis*.

MURDANNIA SPIRATA

Murdannia spirata (L.) G. Brückner, which ranges from India and Sri Lanka to Taiwan, the Philippines, and Java, is the most common, widespread, and variable species of *Murdannia* in Sri Lanka. In the field some forms appear distinct and seem to merit taxonomic recognition. One of them has characteristic seeds, and thus it can also be recognized in the herbarium. It is described below as *M. striatipetala* Faden. Among the plants retained in *M. spirata* some variants are more clearly definable than others, but they all seem to intergrade, at least in dried specimens, and they do not have distinctive seeds. However, one of these variants is so easily recognizable in the field that it is described below as *Murdannia spirata* var. *parviflora* Faden.

For the sake of completeness, the infraspecific taxa of *M. spirata* recognized in Faden (2000), including two as yet unnamed, can be distinguished by the following key. In the absence of a detailed study of *M. spirata* throughout its range, these distinctions may not hold outside of Sri Lanka.

1a. All leaves 5 mm wide or less, some or all arcuate and conduplicate . . . . . *Murdannia spirata* var. A
1b. Some or all leaves broader than 5 mm, leaves rarely arcuate or conduplicate.
  2a. Peduncles uniformly pubescent; distal leaves with lamina pubescent on one or both surfaces, at least along the midrib below . . . . . *Murdannia spirata* var. B
  2b. Peduncles glabrous (rarely with a longitudinal line of very fine hairs); distal leaves with lamina usually glabrous (rarely pubescent beneath along the midrib).
    3a. Plants with or without a definite base; flowers (6.5–)8.5–13 mm wide; petals uniformly colored . . . . . *Murdannia spirata* var. *spirata*
    3b. Plants with a definite base, although shoots sometimes decumbent; flowers 5–8 mm wide; petals with contrasting, dark veins . . . . . *Murdannia spirata* var. *parviflora*

Murdannia spirata (L.) G. Brückner var. **parviflora** Faden, var. nov. TYPE: Sri Lanka. Jaffna: Mulamana, mile post 35/1 on Mannar–Jaffna road, 9°16′30″N, 80°08′20″E, alt. under 30 m, growing under shrubs, 11 Jan. 1977, *R. B. Faden & A. J. Faden 77/133* (holotype, US 2891062; isotypes, F, K, PDA).

A varietate *spirata* floribus parvioribus petalis nervatura fusca differt.

Ascending to decumbent annual herbs with a definite base; lamina lanceolate or lanceolate-elliptic to ovate, 1–3(–3.5) cm long, (0.3–)0.5–1.1 cm wide, rarely some conduplicate or arcuate, glabrous (rarely sparsely pubescent along the midrib beneath); terminal inflorescence composed of 1–2 (rarely 3 in an umbel) cincinni; peduncles glabrous or, occasionally, with a longitudinal line of pubescence (rarely with scattered hairs); flowers 5–8 mm wide; petals with contrasting, dark veins; stamens not dimorphic; staminode filaments glabrous or bearded.

Distribution. Sri Lanka; naturalized in the United States (Florida).

Habitat. Under shrubs and trees, shaded roadsides and ditches, open fields, and edge of rocky areas on forested hills, 0–150 m; flowering December, January (in Sri Lanka), flowers opening in the field 1010–1100 hr, fading 1200 hr.

Chromosome numbers: $2n = 40$ (from *Faden & Faden 77/192*, cytology voucher slides #85/146 & 85/147); $2n =$ ca. 40 (from *Plowman 13266*, cytology voucher slide #85/056, all US).

The characteristic features of *M. spirata* var. *parviflora* are the presence of a definite base in the plants, and, especially, the small flowers that have dark-veined petals and lack stamen dimorphism and enantiostyly, or mirror-image symmetry. This variety is also much less aquatic than any of the others.

In Sri Lanka, I found this plant so distinctive, both morphologically and ecologically, that I thought it might merit specific rank. However, herbarium specimens, in which the diagnostic floral characters were lacking, were not readily distinguishable from the other broad-leaved varieties of *M. spirata.*

It is noteworthy that *M. spirata* var. *parviflora* is tetraploid, whereas the only other count of *M. spirata* obtained from Sri Lankan plants (from *Faden & Faden 76/631, Murdannia spirata* var. B, cytology voucher slides #83/084 & 83/085, US) was diploid. In the literature *M. spirata* has been reported as diploid (Sharma & Sharma, 1958, as *Aneilema spiratum*) and tetraploid (Bhattacharya, 1975) in India (see Rao et al., 1972, for summary) and tetraploid in Taiwan (Peng, 1987). The Taiwanese plant corresponds to *M. spirata* var. *spirata* in Sri Lanka, but I have not seen vouchers for any chromosome count from India.

The naturalized plants of *Murdannia spirata* in Florida all probably belong to variety *parviflora.* Living plants grown from seed of *Plowman 13266* (US) definitely matched the Sri Lankan plants. Petals with contrasting dark veins have been observed in *Lakela 31640* (UNC, USF), but this character could not be observed in any other collection. Al-

though it is likely that all collections from Florida belong to the same variety, there is no hard evidence to support this. The species was first collected in the United States in 1965. I have seen 13 collections from 5 Florida counties: Charlotte, Collier, Glades, Hendry, and Lee.

Paratypes. SRI LANKA. **Anuradhapura:** Wilpattu National Park, Waliella, *Faden & Faden 77/75* (F, PDA, US); Gnanikkulama, km 118.4–120 on Anuradhapura–Kandy road, *Faden & Faden 77/164* (F, PDA, US); Mihintale, Mahasana Hill, *Faden & Faden 77/192* (F, PDA, US). **Jaffna:** 1.6 km from Pooneryn on Pooneryn–Paranthan road, *Faden & Faden 77/152* (F, PDA, US); Puliyampokkana, mile post 8/2 on Paranthan–Mullaittivu road, *Faden & Faden 77/229* (F, PDA, US). **Mannar:** Nayorpalam, Vidathal Tivu Water Supply turnoff road, *Faden & Faden 77/128* (F, PDA, US). **Trincomalee:** Gatalawa, Gatalawa Hill, *Faden & Faden 77/256* (F, PDA, US). U.S.A. **Florida:** Lee, Buckingham, Cemetery Road, *Plowman 13266* (US).

Murdannia striatipetala Faden, sp. nov. TYPE: Sri Lanka. Jaffna: Jaffna–Pooneryn ferry road, mile post 7/4, Arukuveli, ca. 9°37′N, 80°10′E, just above sea level, 22 Jan. 1977, *R. B. Faden & A. J. Faden 77/202* (holotype, US 2890333; isotypes, E, F, K, L, PDA). Figure 1H–N.

Herbae annuae; inflorescentiae plerumque paribus oppositis cincinnorum compositae; flores dimorphi, petalis pallide caseiis nervatura fusciore, staminibus 3 filis barbatis pilis brevibus appressis, polline albo, staminodiis 3 filis glabris; capsulae (2.5–)3–4.5(–5) × 1.5–2 mm, loculis (4–)5–7 spermis; semina uniseriata, 0.35–0.95 × (0.55–)0.6–0.9 mm, testa alveolata, scrobiculata vel alveolato-reticulata.

Unbranched to tufted annual 5–20(–25) cm tall with a definite base, shoots erect to ascending or decumbent and rooting at the lower nodes; roots thin, fibrous. Leaves sometimes decrescent on the flowering shoots, sheaths 0.1–0.5 cm long, glabrous to ciliate at the apex, lamina narrowly lanceolate to lanceolate-oblong, (0.4–)1–3.5(–4.5) cm long, (0.1–)0.2–0.6(–0.8) cm wide, apex acute, base rounded to amplexicaul, both surfaces glabrous, margins scabrous. Inflorescences terminal and axillary from the upper leaves, glabrous, the terminal pedunculate, consisting of a pair (rarely 1, or 3 in an umbel) of opposite, elongate, ascending cincinni; peduncle (0.6–)1–2(–4) cm long, usually glabrous (rarely with a line of pubescence); cincinni to 4 cm long and 13-flowered; bracteoles spaced 1–5 mm apart, amplexicaul, not perfoliate. Flowers bisexual or male, (7.5–)8.5–13 mm wide; pedicels erect in fruit, 2–8.5 mm long, glabrous; sepals ovate to ovate-lanceolate, ovate-elliptic or lanceolate-elliptic, (2–)2.5–4 × 1.5–2 mm, glabrous; petals orbicular to ovate-orbicular, 3–5.5 × 3–5.3 mm, pale lavender with dark, contrasting veins, margin crenulate; stamens 3, bending to one side of the flower, the style to the other in the bisexual flower, symmetrically arranged in the male flower, filaments 2–3 mm long, densely bearded below the middle with short, appressed hairs, anthers elliptic to oblong-elliptic, (0.7–)1–1.3 × 0.5–0.7 mm, pollen white; staminodes 3, filaments 1–1.5 mm long, glabrous, antherodes 3-lobed, 0.4–0.5 × 0.5–0.85 mm, creamy white or creamy yellow; ovary ellipsoid-trigonous, 1–1.3 × 0.5–0.6 mm, green, style 1.7–2.35 mm long, mauve at least basally, stigma capitate, white. Capsules oblong-ellipsoid, (2.5–)3–4.5(–5) × 1.5–2 mm, brown, glabrous. Seeds uniseriate, (4–)5–7 per locule, ovate to trapezoidal or rectangular in outline, 0.35–0.95 × (0.55–)0.6–0.9 mm, testa gray or gray-brown, alveolate to scrobiculate or alveolate-reticulate, rarely shallowly reticulate-foveolate, hilum punctiform to elliptic, dark brown, embryotega semilateral (rarely lateral or semidorsal).

Distribution. Northern Sri Lanka and southern India.

Habitat. Abandoned paddies, ditches, vicinity of water holes, moist, open sandy areas dominated by small annuals, seasonally swampy places, grazed grasslands, and edges of small shrubs and thickets; from sea level to 30 m; flowering January, February in Sri Lanka, in November, February, and March in India, flowers opening in the field ca. 1030–1100 hr, fading ca. 1300 hr.

Faden & Faden 77/232A (F, PDA, US) is perhaps a mixed collection, one element of which is definitely *M. striatipetala.* One of the two plants on the US sheet has two inflorescences composed of whorls of three cincinni, which would be rare in *M. striatipetala* but common in *M. dimorphoides.* This plant also has the longest leaves among the specimens of *M. striatipetala* examined, but it is well within the range of *M. dimorphoides* in this character. In view of these features, plus the fact that *M. dimorphoides* was collected at the same locality, the possibility of a misidentification was considered. The pressed flowers seem to have the short stamen filament hairs of *M. striatipetala.* Unfortunately, no mature capsules are present on the plant, so certain identification cannot be made. The liquid-preserved flowers are inconclusive. They indicate either a mixed collection or a very variable population. The second plant on the sheet has a seed and is definitely *M. striatipetala.*

Murdannia striatipetala is closely related to *M.*

spirata and, in view of the great variability in that species, I was tempted not to treat it as a new species. However, in the field plants of *M. striatipetala* were distinct, being recognizable by their definite base, narrow leaves, dark-veined petals, and short appressed hairs on the stamen filaments. Fruiting specimens had generally more seeds per locule (5 to 7 vs. 3 to 4 in most populations of *M. spirata*) and distinctive seeds that lacked warts. In addition, within Sri Lanka, *M. striatipetala* is restricted to the northern part of the island whereas *M. spirata* is much more widespread.

Murdannia striatipetala closely resembles *M. dimorphoides*. The differences are discussed under that species (above).

Paratypes. SRI LANKA. **Jaffna:** Point Pedro, *Clayton 5210* (K, PDA, US); Mulamana, mile post 35/1 on Mannar–Jaffna road, *Faden & Faden 77/136* (F, PDA, US); Jaffna–Pooneryn road, mile 4.5, Tanankilappu, *Faden & Faden 77/141* (F, PDA, US); Jaffna–Pooneryn road, just before ferry crossing, *Faden & Faden 77/148* (F, PDA, US); Jaffna–Kandy road, just before Jaffna town signboard, *Faden & Faden 77/200* (F, PDA, US); Jaffna–Pooneryn ferry road, mile post 7/4, Arukuveli, *Faden & Faden 77/202* (F, PDA, US); ca. 1.6 km from Pooneryn on Pooneryn–Paranthan road, *Faden & Faden 77/217* (F, PDA, US); Nallur on Poonreyn–Paranthan road, km 16, *Faden & Faden 77/219* (F, PDA, US); Ampan on Point Pedro–Merutenkeni road, ca. mile post 10/1, *Faden & Faden 77/227* (F, PDA, US); between Jaffna–Kandy road and Mulliyan, ca. 48 km ESE of Jaffna, *Townsend 73/82* (K, PDA, US). **Vavuniya:** Paranthan–Mullaittivu road, mile post 27/2, *Faden & Faden 77/235* (F, PDA, US); Mullaittivu, *Faden & Faden 77/239* (F, PDA, US). INDIA. **Districts unknown:** Tambaram, *Barnes 716* (K), *717* (K); Tada, *Bourne 2784* (K); Nungambakam, 15 Nov. 1899, *Bourne* (from K. Rungachari) *s.n.* (K); Chinghput, Guindy, 1885, *Lawson s.n.* (K).

Murdannia vaginata

Murdannia vaginata (L.) G. Brückner is a common lowland species in Sri Lanka. It ranges from there and India to northern Australia. Its inflorescence and floral morphology are so distinctive that *Murdannia* sect. *Vaginatae* was described for it and two related species, *M. medica* (Loureiro) D. Y. Hong and *M. spectabilis* (Kurz) Faden (Faden, 1980). In Sri Lanka there are two very distinct types of plants within *M. vaginata* that are worthy at least of varietal rank. They may be separated as follows:

1a. Roots (dried) < 1.3 mm thick; flowers all bisexual, 6–11.5 mm wide; stamen filaments not dimorphic between different flowers; sepals densely to sparsely pubescent; capsules 2.5–3.3 mm wide; seeds 1.6–1.8 mm wide, foveolate-reticulate, without a fine, raised reticulum . . . . . *M. vaginata* var. *vaginata*

1b. Roots (dried) to 2 mm thick; flowers bisexual or male, 9–15 mm wide; stamen filaments dimorphic between the bisexual and male flowers; sepals glabrous or subglabrous; capsules 2 mm wide; seeds 1.3–1.6 mm wide, smooth to alveolate-reticulate, with a fine, raised reticulum . . . . . *M. vaginata* var. *glabrisepala*

Murdannia vaginata (L.) G. Brückner var. **glabrisepala** Faden, var. nov. TYPE: Sri Lanka. Colombo: Muthuraja Wela, Nugape, at junction of road to Bopitya and Kandana, 7°03′N, 79°51′40″E, sea level, 30 Nov. 1976, sedge marsh, *R. B. Faden & A. J. Faden 76/419* (holotype, US 2890350; isotypes, AAU, B, C, E, F, G, GH, K, L, MO, NSW, P, PDA, TI, US).

A varietate *vaginata* sepalis glabris vel subglabris, capsulis angustioribus, seminibus angustioribus testa laevi vel alveolato-reticulata reticulo tenui prominenti differt.

Plants apparently perennial, flowers bisexual or male; stamens bending to one side of the flower, the style to the other in the bisexual flower, or symmetrical and divergent in the male flower; sepals glabrous to subglabrous; style white; capsules 3–3.5 × 2 mm; seeds 1.75–2.2 × 1.3–1.6 mm, smooth to alveolate-reticulate, with a fine, raised reticulum.

Distribution. Sri Lanka and perhaps elsewhere in tropical Asia (see below).

Habitat. Moist, open sandy areas around seasonal pools and sedge marshes with *Xyris*, *Eriocaulon*, and *Drosera*; sea level; flowering November, January, flowers open in the field 0920–0950 hr.

Although *Murdannia vaginata* was correctly considered common in the "low country" in the *Handbook to the Flora of Ceylon* (Hooker, 1898), it was little collected until recently. Despite its very distinctive inflorescence it has sometimes been confused by collectors with other annual species. However, it has many features that make it unique among Sri Lankan species of *Murdannia*: bractless sheaths surrounding fascicles of one-flowered cincinni; pubescent pedicels; usually pubescent sepals; four staminodes with well developed antherodes; orange or orange-yellow pollen; and one-seeded capsule locules. Variety *vaginata* is definitely annual; variety *glabrisepala* might be perennial because of its relatively thick roots.

Murdannia vaginata var. *glabrisepala* is decidedly uncommon in Sri Lanka. We encountered it only twice in three months of collecting, whereas we made 13 collections of variety *vaginata*. Both varieties were found growing and flowering together in Batticaloa District (*Faden & Faden 77/278*, US, etc., and *77/280*, US, etc.) without evidence of in-

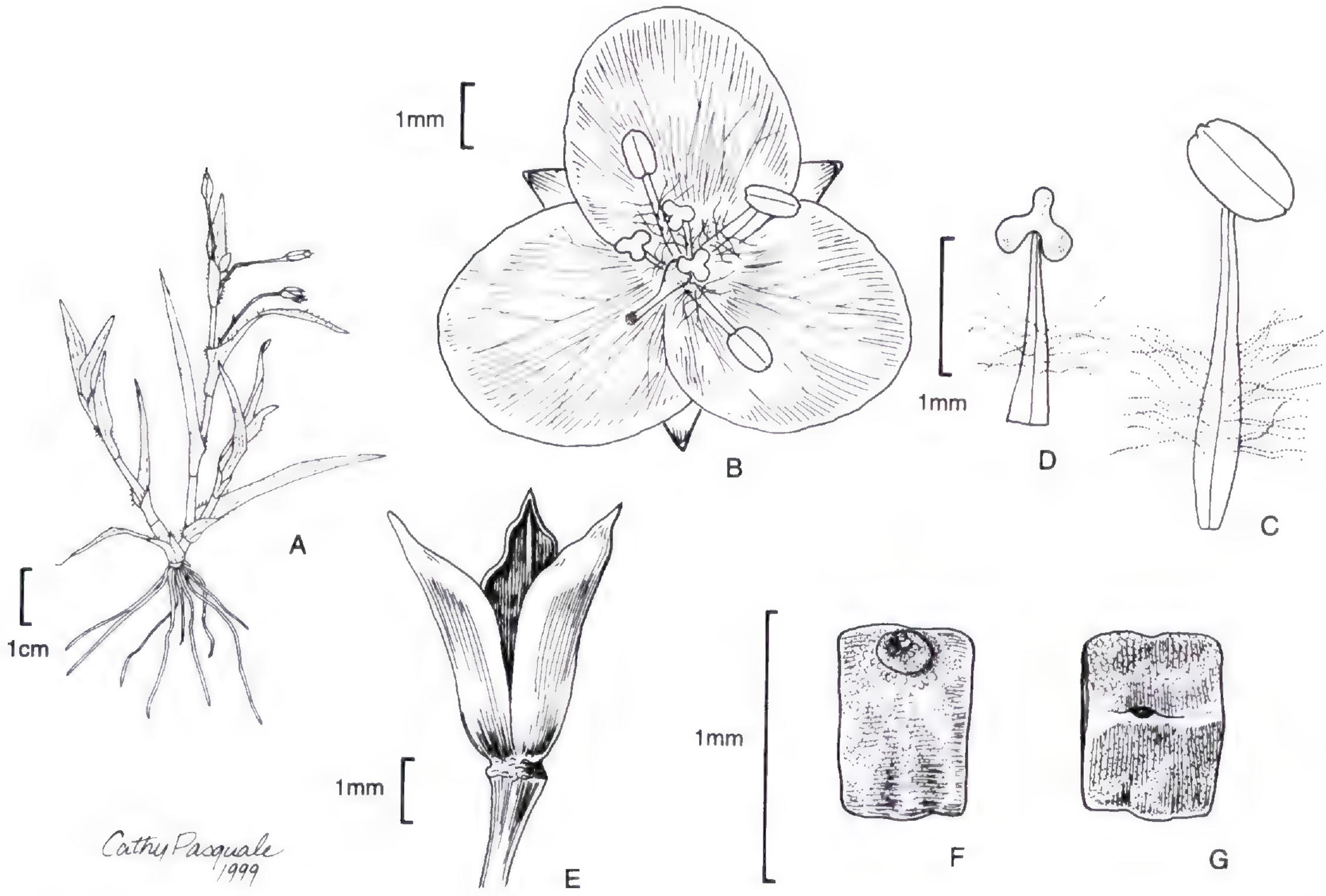


Figure 2. *Murdannia audreyae* Faden. —A. Habit. —B. Bisexual flower. —C. Stamen. —D. Staminode. —E. Capsule. —F. Seed, dorsal view. —G. Seed, ventral view. A and B are from *Faden & Faden 77/146* and C–G from *Faden & Faden 77/204*. Drawings by Audrey J. Faden (A) and Cathy Pasquale (B–G).

termediates. The two sheets of *C.P. 2328* in PDA (see below) are mixtures of the varieties. The K and BM sheets of this number are entirely variety *vaginata*.

The two varieties recognized here may be easily separated in Sri Lanka. Variety *vaginata* is also easily recognized throughout its wide range. Variety *glabrisepala*, however, is more problematic. Specimens showing some of its characters, e.g., glabrous or subglabrous sepals, have been seen from India, Myanmar, Thailand, Malaysia, Vietnam, and Java, but they do not exactly match the plants from Sri Lanka in all features, so their status is undetermined. It is possible that the two varieties in Sri Lanka represent extreme forms of a very variable species that reached the island independently from the mainland. In Sri Lanka they seem to function as distinct species, although their final status cannot be resolved until the species as a whole is studied throughout its range.

Paratypes. SRI LANKA. **Batticaloa:** Karuvakkeni, Batticaloa–Trincomalee road, mile post 19, *Faden & Faden 77/278* (F, PDA, US). **Galle:** near Bentota, May 1859, [*Thwaites in*] *C.P.2328* (PDA [same sheets as *Gardner s.n. in C.P.2328*]) (mixture with var. *vaginata*). **District unknown:** Padcambra, *Gardner s.n. in C.P.2328* (PDA [same sheets as *Thwaites in C.P.2328*]) (mixture with var. *vaginata*). **Locality Unknown:** *Jonville s.n.* (BM).

Murdannia audreyae Faden, sp. nov. TYPE: Sri Lanka. Northern Province, Jaffna: Jaffna–Pooneryn ferry road, mile post 7/4, Arukuveli, ca. 9°37′N, 80°10′E, just above sea level, 22 Jan. 1977, *R. B. & A. J. Faden 77/204* (holotype, US 2890994; isotypes, AAU, C, E, F, K, L, MO, NSW, P, PDA, TI, US). Figure 2.

Herbae annuae surculis (2–)5–10(–22) longis; inflorescentiae 1–6 cincinnis unifloris compositae; flores violacei vel atrocaesii, staminibus 3, staminodiis 3, filis omnibus barbatis, polline albo; capsulae 3–5 × 1.2–2.2 mm, loculis 4–6 spermis; semina uniseriata, 0.35–0.8 × 0.55–0.75 mm, testa alveolata, rugosa vel scrobulata.

Unbranched or tufted annual with erect to decumbent shoots (2–)5–10(–22) cm long, usually rooted only at the base, occasionally also along the stems. Leaves strongly decrescent distally on the flowering shoots, sheaths to ca. 0.5 cm long, ciliate at the apex, lamina linear to linear-lanceolate or (uppermost leaf) lanceolate, 1–6 cm long, 0.2–0.4 cm wide, apex acute to acuminate, base amplexicaul or rounded, both surfaces glabrous to hirsute, margins scabrous. Inflorescences terminal and ax-

illary in the upper leaves, consisting of fascicles of 1 to 6 1-flowered cincinni, occasionally some inflorescences more developed and composed of 2 alternate or opposite cincinni, each 1-flowered (rarely up to 3-flowered), 1-flowered cincinni 0.8–2(–3) cm long, with 2 persistent bracts (rarely more), glabrous or rarely pubescent. Flowers bisexual (rarely male), usually vertical, 7.5–11.5 mm wide; pedicels 4.2–8 mm long, always exceeding the cincinnus peduncle, glabrous; sepals lanceolate or lanceolate-oblong to ovate-elliptic, ovate-lanceolate or ovate, 2.5–4.5 × 1.2–1.8 mm, glabrous; petals broadly elliptic to ovate-elliptic, ovate-orbicular or obovate-orbicular, violet to dark lavender; stamens 3, symmetrically arranged or, more commonly, bending to one side of the flower (away from the style), filaments 1.4–2.5 mm long, violet or whitish, densely bearded below the middle with long, patent, violet or lavender-violet hairs, anthers elliptic to oblong-elliptic, (0.7–)0.8–1.3(–1.4) × 0.3–0.6 mm, pollen white; staminodes 3, filaments 0.7–1.5 mm long, pale lavender to violet, sparsely to densely bearded, antherodes 3-lobed, white or creamy yellow, sometimes tinged with lavender in the center; ovary oblong-elliptic, 0.75–1.5 × 0.45–0.7 mm, green or whitish, style central in the flower or curving to one side, 0.8–1.4(–1.7) mm, lavender to violet, stigma capitate, white. Capsule oblong-ellipsoid, 3–5 × 1.2–2.2 mm, locules 4–6-seeded. Seeds uniseriate, mostly rectangular to quadrate or ovate in outline, 0.35–0.8 × 0.55–0.75 mm, testa light tan or beige, alveolate to rugose or scrobiculate, hilum elliptic, lateral on a raised midventral ridge, embryotega lateral.

Distribution. Sri Lanka (endemic).

Habitat. Open sandy areas dominated by small annuals, sometimes among bushes, in scrub or forest, also abandoned paddies and paddy ridges; 0–50 m; flowering January, flowers opening in the field ca. 1045 hr, fading 1245 hr.

Chromosome number: $2n = 20$ (from plants grown from seed of *Faden & Faden 77/204*; cytology voucher slide #84/064, US).

In the field the staminode filaments were sometimes recorded as glabrous, but preserved flowers from at least four populations consistently showed them to be bearded.

Murdannia audreyae belongs to a group of species that has been defined by reduced inflorescences composed of one-flowered cincinni arranged in terminal and axillary fascicles (group A, Pauciflorae, of Brückner, 1930). Although this is clearly an artificial group, it provides a starting point for looking for morphologically similar species. Among the Asian species with this inflorescence type, only *M. keisak* (Hasskarl) Handel-Mazzetti, *M. triquetra* (Wallich ex C. B. Clarke) G. Brückner (which is sometimes considered synonymous with *M. keisak*), and *M. yunnanensis* D. Y. Hong have pink to violet flowers and uniseriate seeds. The first two species differ from *M. audreyae* in having broader leaves (3–10 mm wide), larger capsules (5–10 × 2–4 mm), a regularly decumbent to repent habit, and in being more aquatic, commonly growing in water. *Murdannia yunnanensis* differs from the new species in having broader (7–13 mm wide), elliptic to ovate leaves. *Murdannia audreyae* further differs from all of these by occasionally having small, thyrsiform inflorescences among those composed of single cincinni. Thus it forms something of a bridge between the species that always have thyrsiform inflorescences and those that always have single-flower cincinni in fascicles.

Two other species of *Murdannia* in Sri Lanka also have one-flowered cincinni, but neither is closely related to *M. audreyae*. *Murdannia blumei* (Hasskarl) Brenan has pink to lilac flowers that are barely exserted from the leaf sheaths, shorter pedicels (2–2.5 mm), larger capsules (6–8 × 2.5 mm), and 14–16 biseriate seeds per capsule locule. *Murdannia vaginata,* as noted above, has the cincinni arising from bladeless sheaths, flowers with two stamens and four staminodes, yellow pollen, and one-seeded capsule locules.

This species is named in honor of my wife, Audrey Joy Faden, who first spotted the plant during our fieldwork in Sri Lanka in 1976 and 1977. The predominantly violet flowers of the new species make it stand out from all other *Murdannia* species in Sri Lanka.

Paratypes. SRI LANKA. **Batticaloa:** Karuvakkeni, mile post 19 on Batticaloa–Trincomalee road, *Faden & Faden 77/273* (F, PDA, US). **Jaffna:** Arukuveli, ca. km 11.2 on Jaffna–Pooneryn road, *Faden & Faden 77/146* (F, PDA, US); Nallur on Pooneryn–Paranthan road, km 16, Jan. 1977, *Faden & Faden 77/220* (F, PDA, US); Soranpattu on road from main Jaffna–Kandy road to Talalady, *Faden & Faden 77/225* (F, PDA, US). **Vavuniya:** Panikkankulam Forest Reserve, Panikkankulam, Nanukulam–Paranthan road, mile post 144/2, *Faden & Faden 77/196* (F, PDA, US); Mullaittivu, Mullaittivu–Nankulam road, just before Mullaittivu sign board and mile post 29, *Faden & Faden 77/243* (F, PDA, US).

Discussion

The propriety of using both subspecies and varieties within the same genus has been questioned by a reviewer and needs an explanation. I use subspecies for an infraspecific variant that has a geographic basis, regardless of the magnitude of the

differences between it and other variants within the species. I use variety to denote an important difference among infraspecific taxa, but one that does not have a geographic basis. I do not consider minor variation lacking a geographic basis, e.g., flower color, to merit formal taxonomic recognition.

The flowers or stamens have been described as dimorphic in some of the taxa described above. When they are dimorphic (*M. dimorphoides* subsp. *dimorphoides*, *M. dimorphoides* subsp. *perennis*, *M. striatipetala*, *M. vaginata* var. *glabrisepala*, *M. audreyae* (sometimes)), there are usually two types of dimorphism. The first is the dimorphism between the bisexual and male flowers. In the bisexual flowers, the fertile stamens all bend to the same side of the flower, away from the style, which typically bends in the opposite direction. The androecium is manifestly asymmetric. In the male flowers of these species, the stamens are evenly spaced and symmetrically arranged.

The second type of dimorphism is enantiostyly. In the bisexual flowers the stamens may bend either to the left or the right side of the flower. Successive flowers on a cincinnus alternate in the direction in which the stamens bend, so the two flower forms are produced in equal numbers. The pattern of flowering and proportion of the different morphs in taxa that have only one-flowered cincinni, such as *M. vaginata* var. *glabrisepala* and *M. audreyae*, are unknown.

Acknowledgments. I thank my wife, Audrey J. Faden, for finding the *Murdannia* that is named herein in her honor and for illustrating its habit in the field, Cathy Pasquale for the other illustrations, and the late Royce Oliver for help with the chromosome counts. Fieldwork in Sri Lanka was conducted in 1976–1977, when I was employed by the Field Museum of Natural History, Chicago. It was supported by the Smithsonian Institution's Flora of Ceylon Project.

Literature Cited

Bhattacharya, B. 1975. Cytological studies on some Indian members of Commelinaceae. Cytologia 40: 285–299.

Brückner, G. 1930. Commelinaceae. Pp. 159–181 *in* A. Engler, Die natürlichen Pflanzenfamilien, 2nd ed., Vol. 15a. Wilhelm Engelmann, Leipzig.

Faden, R. B. 1980. The taxonomy and nomenclature of some Asiatic species of *Murdannia* (Commelinaceae): The identity of *Commelina medica* Lour. and *Commelina tuberosa* Lour. Taxon. 29: 71–83.

———. 2000. Commelinaceae. Pp. 116–196 *in* M. D. Dassanayake & W. D. Clayton (editors), A Revised Handbook to the Flora of Ceylon, Vol. 14. A. A. Balkema, Rotterdam.

Hooker, J. D. 1898. Commelinaceae. Pp. 298–316 *in* H. Trimen & J. D. Hooker, A Handbook to the Flora of Ceylon, Part 4. Dulau, London.

Peng, C.-I. 1987. *Murdannia spirata* (L.) Brückner (Commelinaceae), a neglected species in the flora of Taiwan. J. Taiwan Mus. 40: 51–56.

Rao, R. S., R. S. Raghavan & R. V. Kammathy. 1972. Biosystematic studies on Indian Commelinaceae: The chromosome pattern and evolutionary trends. Bull. Bot. Surv. India 12: 242–254.

Sharma, A. K. & A. Sharma. 1958. Further investigations on cytology of members of Commelinaceae with special reference to the role of polyploidy and the origin of ecotypes. J. Genet. 56: 63–84.

Wight, R. 1853. Icones Plantarum Indiae Orientalis or Figures of Indian Plants, Vol. 6. J. B. Pharaoh, Madras.

A New Species of *Tradescantia* (Commelinaceae) from Costa Rica

Robert B. Faden

Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A.

ABSTRACT. A new species of *Tradescantia* (sect. *Cymbispatha*), *T. grantii* Faden, is described from Costa Rica. Based on its morphology and karyotype the new species is most closely related to *T. plusiantha* from Mexico and probably *T. deficiens* from Mexico and Guatemala.

Key words: Commelinaceae, Costa Rica, *Tradescantia.*

While preparing a treatment of the Commelinaceae (Grant, Faden & Hammel, submitted to the editors) for the *Manual de las Plantas de Costa Rica* (Hammel et al., in prep.), it became necessary to deal with some specimens of an unnamed, white-flowered *Tradescantia* from Costa Rica that I had known for many years. A new collection of the plant by Jason Grant, including living plants, enabled me to confirm that it was a new species, which is described below as *Tradescantia grantii* Faden.

SECTION *CYMBISPATHA*

Tradescantia grantii Faden, sp. nov. TYPE: Costa Rica. Puntarenas: Jardin Botánico R. & C. Wilson, Coto Brus, San Vito, Las Cruces, 8°47′20″N, 82°58′30″W, 1200 m, small valley along the Río Jaba in virgin swatch of forest adjacent to the grounds of the gardens, 9 Jan. 1992, *J. R. Grant & J. R. Rundell 92–01801* (holotype, US; isotypes, CR, F, K, MEX, MO, U). Figure 1.

Herbae perennes decumbentes; folia spiraliter disposita, pagina adaxiali glabra, pagina abaxiali in nervis pubescenti; paria cymarum (2)3 ad 15 per surculum, distaliter portata, bractea tertia plerumque nulla; spathae basibus cuneatis, pubescentibus, in marginibus ciliolatis; flores albi, stamina filis glabris, connectivis V-formibus.

Decumbent perennial, roots thin, fibrous; lateral shoots perforating the sheaths; lower internodes 5–8 cm, sparsely pilose to glabrescent; leaves spirally arranged, sheaths ca. 0.5 cm, tawny hirsute, especially along the fused edge, densely ciliate at the apex, with similar hairs, lamina petiolate, elliptic to lanceolate-elliptic or ovate, 5–12 × (1.5–)2–3.5 cm, petiole to 1 cm, puberulous on the midrib below, apex acute to acuminate, base symmetric, cuneate, adaxial surface glabrous, abaxial sparsely pubescent along the midrib and veins, margins sparsely to densely appressed ciliate. Flowering shoots ascending, 10–30 cm tall, with internodes decreasing distally and leaves clustered toward the end of the shoot. Inflorescences cyme-pairs, (2)3 to 15 per flowering shoot, borne terminally and from the axils of the upper leaves; peduncles erect to somewhat spreading, 1–4.5 cm, uniformly puberulous with tawny, uniseriate hairs, or the hairs present only in a broad vertical band; supernumerary bracts usually lacking; spathes spreading to ascending, 1.2–2.3 × 0.4–0.65 cm, folded, elliptic to ovate, apex acute to obtuse, sometimes mucronulate, base cuneate (usually narrowly, rarely broadly), usually densely puberulous basally, sparsely puberulous along the folded edge (midrib) above the base, margins ciliolate. Bracteoles easily visible between the spathes, 1–2 mm long, glabrous or sparsely pubescent. Flowers bisexual, ca. 5 mm wide; pedicels 2–4 mm long, glabrous or with a vertical line of sparse hairs; sepals unequal, green, outer sepal lanceolate-ovate, strongly keeled, hooded at apex, longer than the inner sepals, 2.5–3.5 × 1 mm, puberulous along the keel, inner sepals ovate to ovate-elliptic or lanceolate-elliptic, not keeled, 2–3 × 1–1.2 mm, glabrous; petals subequal, not clawed, obovate-elliptic to obovate or ovate-trullate, 2–2.8 × 1.2–2 mm, white; stamens 6, subequal or irregularly variable in length, filaments 1.9–2.8 mm long, glabrous, anthers basifixed, 0.35–0.7 × 0.55–1 mm, connective broad, in the form of an upside-down "V," white, pollen sacs distal, ca. 0.2–0.25 × 0.25–0.3 mm, dehiscence latrorse, pollen white; ovary ovoid-globose, trigonous, 0.9–1.2 × 0.75–0.9 mm, glabrous, white or faintly tinged with purple, locules 3, equal, 2-ovulate, style subterminal, i.e., slightly sunken into ovary apex, straight, 0.6–1 mm long, stigma enlarged to distinctly deltate. Capsules broadly ellipsoid, ca. 2–2.5 × 1.5 mm, dark brown, cells of the wall transversely elongate; seeds uniseriate, 2 per locule (sometimes 1 by abortion), ovoid to ellipsoid, 1.1–1.3(–1.6 in a 1-seeded locule) × 1–1.1 mm, testa pale brown, rugose, the bumps arranged main-

ly in transverse ridges, hilum linear, a little shorter than the seed, embryotega ± lateral, similarly colored to the testa.

Habitat. Wet forest, stream sides, and forest edge; (90–)200–1200 m.

Distribution. *Tradescantia grantii* is known only from Costa Rica on both the Atlantic and Pacific slopes. It likely occurs in Panama because the type locality, the Wilson Botanical Garden, is on the Costa Rica–Panama border.

Chromosome number: $2n = 12$.

Discussion

Plants at the type locality (from label data) were found alongside the path that descends from the cultivated grounds of the Wilson Botanical Garden into the small forested valley of the Rio Jaba. Other plants were found in small clumps in shady, undisturbed undergrowth near the stream.

Some morphological variation was noted in the field and in cultivation. The leaves are very dark green and lustrous on both surfaces, but occasionally they may be purple beneath. The spathes are usually green, but they may be streaked with purple, at least in cultivation. In the field the foliage and spathes are commonly damaged by insects. The roots appear not to penetrate the soil very deeply, but to cling to the surface as the plants trail in their native habitats. The flowers are relatively inconspicuous because of their small size and sparse numbers. They set fruit in the greenhouse in the absence of pollinators, so they are presumed to be self-compatible. Open flowers were observed in the field between 10:30 A.M. and 1:00 P.M. In the greenhouse they open about 11:30 A.M. (in October).

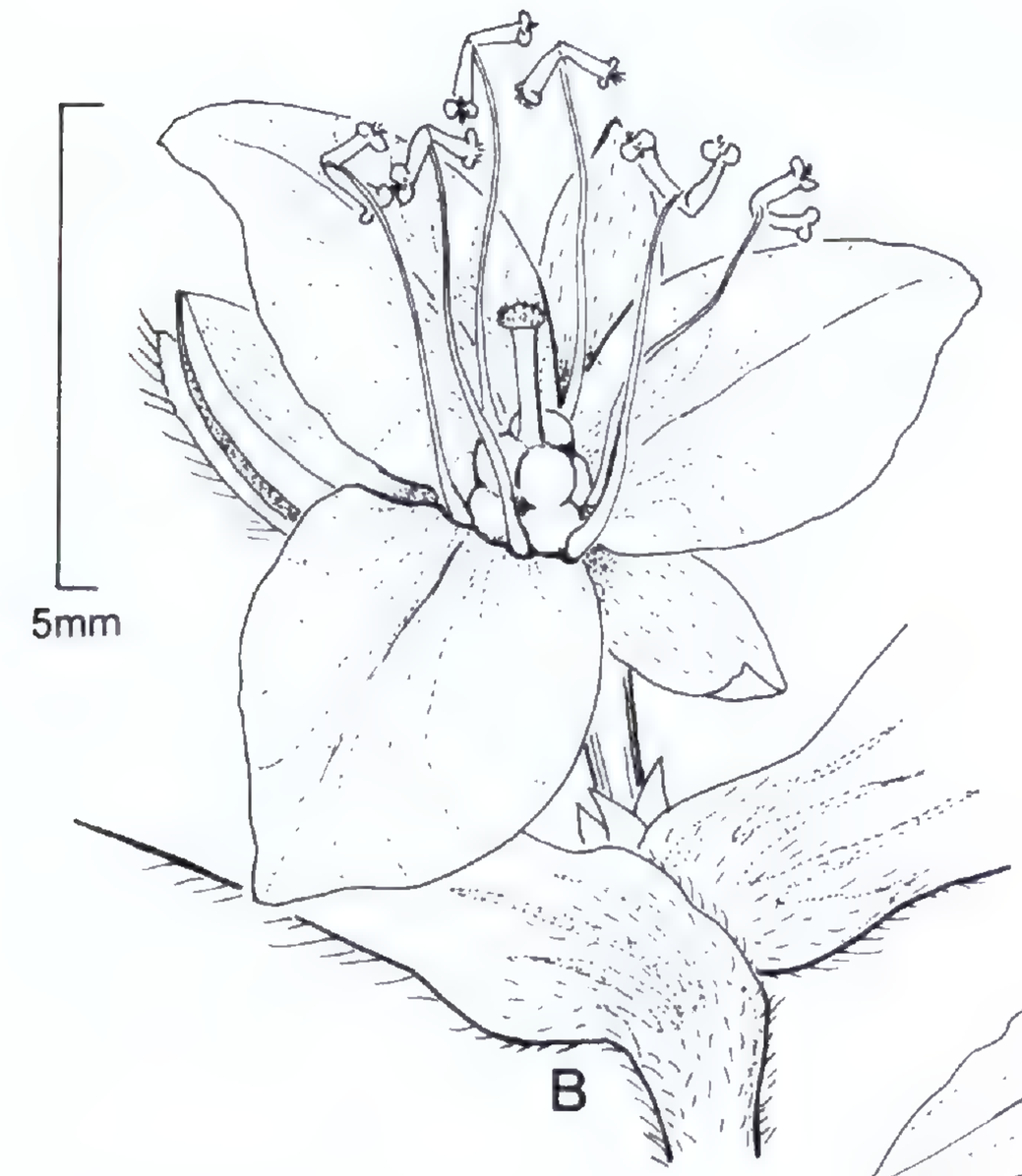
Spathe- or leaf-like bracts sometimes immediately subtend one or both of the spathes of the cyme-pair in some species of *Tradescantia* sect. *Cymbispatha*, e.g., *T. gracillima* Standley and *T. cymbispatha* C. B. Clarke. A single such supernumerary bract has been observed in *T. grantii* in the collection *Kennedy 1384*. Otherwise they are lacking in this species.

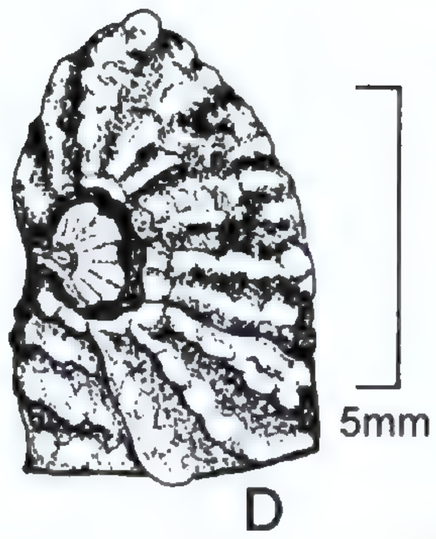
A somatic number of $2n = 12$ was obtained for *T. grantii* by the Royal Botanic Gardens, Kew, in 1992, from cultivated material of *Grant & Rundell 92-01801* (Fig. 2). As is typical for species of *Tradescantia* sect. *Cymbispatha*, the karyotype is composed of acrocentric (10) and metacentric (2) chromosomes, the latter approximately twice the length of the former (Jones et al., 1981). The number of major chromosome arms, with an acrocentric chromosome counting as one and a metacentric as two, is 14, displaying a *nombre fondamental* of seven that is also characteristic of section *Cymbispatha* (Jones et al., 1981).

Tradescantia grantii has been known to me for many years as a probable undescribed species. Hunt (1994) treated these white-flowered Costa Rican plants as possibly belonging to *T. deficiens* Brandegee, a rare plant. I could not adequately describe or differentiate the Costa Rican plant until I obtained living material of it and was able to examine the type of *T. deficiens* (*Purpus 7172*, UC). The most distinctive features of *T. grantii* are the spirally arranged leaves that are pubescent on the veins beneath, the numerous cyme-pairs, the absence of supernumerary bracts, the cuneate-based spathes that are basally pubescent, and the very small white flowers, with glabrous stamen filaments and V-shaped anthers.

Tradescantia grantii appears to be most closely related to *T. plusiantha* Standley, an apparently uncommon species from the states of Chiapas and Oaxaca, Mexico (seven collections seen). This was first suggested by David Hunt (pers. comm.), even before we had living material of the new species. Both species have spirally arranged leaves with symmetric bases, and numerous cyme-pairs. Even more significantly, the karyotype reported here is identical to that of *T. plusiantha* (Jones et al., 1981). *Tradescantia grantii* differs from *T. plusiantha* (Table 1) by the former's perennial habit, the lamina glabrous above and pubescent along the veins beneath (vs. sparsely pilose above and glabrous beneath), the usual absence of supernumerary bracts, the spathes with ± cuneate (vs. ± rounded) bases, the folded edge of the spathe (midrib) puberulous, especially basally (vs. glabrous or with a few distal hairs), the outer sepal with a line of hairs (vs. glabrous or with a few minute apical hairs), the petals smaller and white (vs. usually pink), the filaments glabrous (vs. bearded in the middle or glabrous), and the anther connective a narrow "V" (vs. transversely oblong to deltate).

Tradescantia grantii also shows similarities to *T. deficiens* (Table 1), a species known only from the type locality (Chiapas, Mexico) and a single collection from Guatemala (*Breedlove 11615*, US), in its spirally arranged leaves with symmetric leaf bases and perennial habit (probably perennial in *T. deficiens*). It differs from *T. deficiens* by the lamina glabrous above and pubescent along the veins beneath (vs. glabrous on both surfaces), the spathes clustered (vs. solitary), the base of the spathe ± cuneate (vs. ± truncate), the spathe margins ciliolate (vs. glabrous), the folded edge of the spathe (midrib) puberulous, especially basally (vs. glabrous or





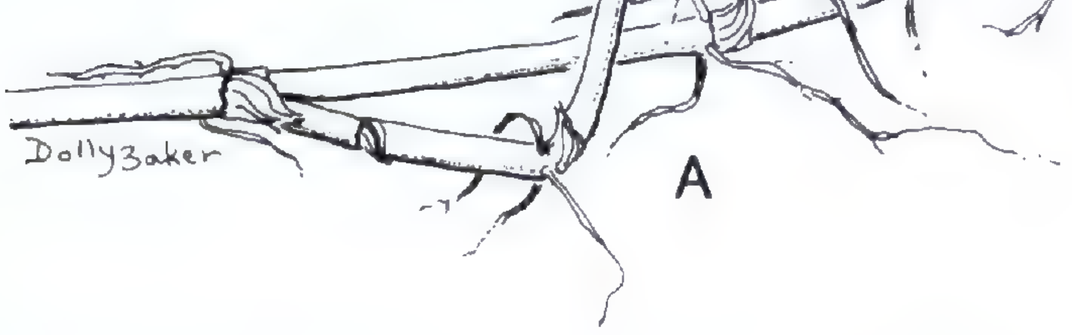


Figure 1. *Tradescantia grantii* Faden. —A. Habit. —B. Flower. —C. Immature fruit. —D. Seed. All from living material of *Grant & Rundell 92–01801*. Illustration by Dolly Baker.

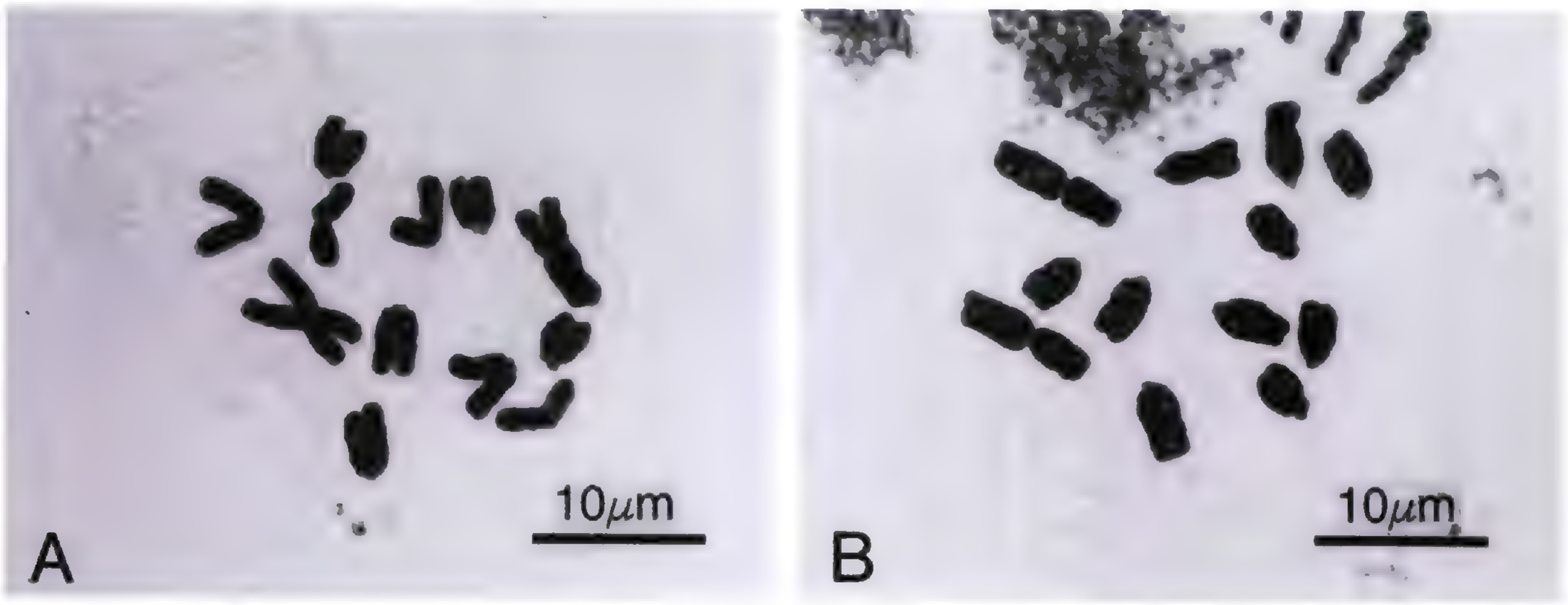


Figure 2. —A, B. Mitotic chromosomes of *Tradescantia grantii* from root tips ($2n = 12$). From living material of *Grant & Rundell 92–01801* (Royal Botanic Gardens, Kew, cytology number 95–332). Root-tip squashes and photomicrographs by Adele Reynolds.

with a few distal hairs), the petals smaller and white (vs. pink), the filaments glabrous (vs. bearded toward the apex), and the anther connective a narrow "V" with distal pollen sacs (vs. circular to deltate with basal pollen sacs).

Some variation has been reported in the floral morphology of *Tradescantia plusiantha*. Hunt (1994) recorded the petals as usually pink. Sometimes they are white, according to label data (*Matuda 4117*, GH). Hunt (1994) described the filaments of this species as glabrous, but in all three collections that I have examined (*Maya 464 & 519*, *Nelson 2825*, all US) they are bearded. When determinable, the hairs were in the middle of the filament. The type description and accompanying illustration of *Tradescantia tonalamonticola* Matuda (Matuda, 1955), a synonym of *T. plusiantha* (Hunt, 1994), record the filaments as bearded in the middle.

Tradescantia grantii is named after Jason Randall Grant (1969–), whose collection and extensive field notes have enabled me to characterize and describe this as a new species.

Paratypes. COSTA RICA. **Alajuela:** tall wet forest E of the Río San Rafael and S of the hot springs, W of La Marina, 10°23′N, 84°23′W, 500 m, 19 May 1968, *Burger*

Table 1. Comparison of *Tradescantia plusiantha*, *T. grantii*, and *T. deficiens*.

	T. plusiantha	*T. grantii*	*T. deficiens*
Petal color	Pink (or white)	White	Pink
Petal length	ca. 4 mm	2–2.8 mm	ca. 4.5–6 mm
Filament bearding	Bearded (or glabrous)	Glabrous	Bearded
Lamina pubescence	Adaxial surface sparsely pilose; abaxial glabrous	Adaxial surface glabrous; abaxial pubescent on midrib & veins	Both surfaces glabrous
Cyme-pairs	Clustered	Clustered	Solitary
Supernumerary bracts	Present	Absent (rarely present)	Absent
Peduncle pubescence	Line of hairs	Usually uniformly puberulous (sometimes a line of hairs)	Line of hairs
Spathe base	± rounded	± cuneate	± truncate
Spathe attitude	Spreading to reflexed	Spreading to ascending	Spreading to ascending
Spathe margins	Ciliolate to ciliate	Ciliolate	Glabrous
Spathe folded edge (midrib)	Glabrous or with a few distal hairs	Puberulous especially basally	Glabrous or with a few distal hairs
Capsule locules	2-seeded	2-seeded	1-seeded(?)
Habit	Annual	Perennial	Perennial
Compatibility	Self-incompatible	Self-compatible	?
Distribution	Mexico	Costa Rica	Mexico, Guatemala

& Stolze 5015 (F); between Cerro Chato and Cerro de los Perditos, Volcán Arenal, 17 Feb. 1989, *Russell & Earthwatch volunteers 751* (US); Canton de San Ramón, Reserva Biológica Monteverde, Río Peñas Blancas Valley, area near Refugio Alemán, 10°18′N, 84°45′W, 900–1100 m, 28 Feb. 1992, *Haber, Bello & Grayum 11291* (US). **Limón:** trail to Rio Madre de Dios from La Lola, 27 Feb. 1972, *Kennedy 1384* (CR); Parque Nacional Braulio Carillo, Sendero Botarama, a la par del Río Sucio, 10°09′00″N, 83°56′5″W, 350 m, 31 Jan. 1991, *Hammel, Maas & Maas 18035* (US). **Puntarenas:** Jardin Bot. R. & S. Wilson, Coto Brus, San Vito, Las Cruces, sendero al río, bosque aledaño al Río Jaba, 8°47′20″N, 82°58′30″W, 1200 m, 7 Feb. 1990, *Gomez-Laurito et al. 11878* (CR).

Acknowledgments. I thank Dolly Baker for the illustration; Jason Grant for collecting the living and herbarium material that yielded the bulk of the information about this species; Adele Reynolds, a former sandwich student—students who "sandwich" a year of work at such places as the Royal Botanic Gardens, Kew, into their university studies—at the Jodrell Laboratory, Royal Botanic Gardens, Kew, for the root-tip squashes and chromosome photomicrographs; and Peter Brandham, Jodrell Laboratory, Royal Botanic Gardens, Kew, for permission to reproduce the chromosome photomicrographs.

Literature Cited

Hunt, D. R. 1994. Commelinaceae. Pp. 157–173 *in* G. Davidse, M. Sousa S. & A. O. Chater (editors), Flora Mesoamericana, Vol. 6. Universidad Nacional Autónoma de México, México D.F.; Missouri Botanical Garden, St. Louis; The Natural History Museum, London.

Jones, K., A. Kenton & D. R. Hunt. 1981. Contributions to the cytotaxonomy of the Commelinaceae. Chromosome evolution in *Tradescantia* section *Cymbispatha*. Bot. J. Linn. Soc. 83: 157–188.

Matuda, E. 1955. Nuevas Commelinaceae de México y Guatemala. Anales Inst. Biol. Univ. Nac. México 26: 59–77.

Paspalum burmanii (Poaceae: Paniceae), a New Species from Central Brazil

Tarciso S. Filgueiras
UPIS-Faculdades Integradas, Departamento de Agronomia & Zootecnia. SEP Sul, EQ 712/912, Conj. A, 70390-125 Brasília, DF, Brazil

Osvaldo Morrone and Fernando O. Zuloaga
Instituto de Botánica Darwinion, Casilla de Correo 22, Labardén 200, San Isidro (B1642HYD), Argentina

ABSTRACT. *Paspalum burmanii*, native to central Brazil, is described as a new species in subgenus *Ceresia*. The new species is morphologically related to *P. humboldtianum* Flüggé, *P. buchtienii* Hackel, and *P. phyllorachys* Hackel by features of its inflorescences, spikelets, and upper anthecium texture and ornamentation. The new species is illustrated and compared with several putatively related taxa. A key to all related species is provided.

Key words: Brazil, Paniceae, *Paspalum*, Poaceae.

In the course of our studies on the grasses of South America, a new species of *Paspalum* was discovered growing near the serpentine outcrops of Niquelândia, in the Brazilian state of Goiás, in central Brazil. This is herein described and placed in subgenus *Ceresia* (Persoon) Reichenbach. Subgenus *Ceresia* includes approximately 25 species ranging from Mexico to northern Argentina and Uruguay.

Paspalum burmanii Filgueiras, Morrone & Zuloaga, sp. nov. TYPE: Brazil. Goiás: Mun. Niquelândia, 14°25′S, 48°26′W, planta ereta, margem da estrada entre Niquelândia e Macedo, cerradão próximo à mata ciliar, ca. 10 km N Niquelândia, estrada para Macedo, 20 maio 1993, *Filgueiras 2471* (holotype, IBGE; isotypes, MO, SI, SP, US). Figure 1.

Paspalo humboldtiano Flüggé simile sed rhizomatibus robustis, non arcuatis, culmis 1.5–2 m altis, non ramigenis, laminis basalibus secus culmosque, 30–35 cm longis et 1–1.2 cm latis, inflorescentiis 20–25 cm longis, 7–11 racemis praeditis, rhachidibus 2.8–3 mm latis, lemmate infero 5-nervio, supra pilosum haud corrugatum et lemmate supero summo glabro recedit.

Robust, rhizomatous, *perennials*, with strong, woody rhizomes, covered with pilose cataphylls; *culms* 1.5–2 m tall, erect, not branched in the vegetative portions; internodes 7–18 cm long, cylindrical, glabrous, lignified, smooth, hollow; nodes compressed, densely pilose, brownish. Blades predominantly basal but also cauline. *Sheaths* 15–22 cm long, longer than the internodes, papillose-pilose, the adaxial surface shining, the margins shortly pilose. *Ligules* 1.8–2.3 mm long, membranous, brownish; pseudoligule absent, collar pilose. *Blades* lanceolate, 30–35 × 1–1.2 cm, reduced toward the apex of the floriferous culm, flat or with involute margins, not pseudopetiolate, the midnerve conspicuous, dense and shortly pilose on both surfaces, the lower portion of the margin with long, tuberculate hairs, otherwise shortly pilose, rounded at the base, the apex acuminate. *Peduncle* subincluded, cylindrical, sparsely pilose. *Inflorescences* terminal, 20–25 × 7–12 cm; main axis 10–18 cm long, flattened, glabrous; racemes 7 to 11, ascendent and divergent from the main axis, alternate, the lower ones 4.5–9 cm long, the upper ones 6–7.5 cm long; pulvini densely pilose, with long and short hairs; rachis of racemes membranaceous, winged, 2.8–3 mm wide, ending in a naked point, glabrous, greenish, the midnerve conspicuous, the veins reticulate, conspicuous, the margins scaberulous; pedicels short, scabrous; spikelets paired, densely imbricate, in four series along the rachis. *Spikelets* long-ellipsoid, 3–4 × 1.2–1.5 mm, exclusive of hairs, plano-convex, greenish to purplish. *Lower glume* absent. *Upper glume* as long as the spikelet, 3-nerved, hyaline, densely papillose-pilose toward the margins, with a fringe of whitish hairs, the hairs 1–2 mm long, otherwise sparsely pilose, the margins purplish, thick and corky at maturity, 3-nerved, with one manifest midnerve and two marginal nerves. *Lower anthecium* neuter, reduced to a lemma. *Lower lemma* 3.2–3.7 mm long, scaberulous, the central portion longitudinally sulcate, 5-nerved, with 3 manifest nerves in the central portion. *Lower palea* absent. *Lower flower* ab-

sent. *Upper anthecium* long-ellipsoid, 2.8–3 × 0.6–0.8 mm, plano-convex, hyaline, gaping at the apex, the apex glabrous, purplish; *upper lemma* 5-nerved, sparsely pilose on the adaxial surface, the margins flat; upper palea 2-nerved, keeled, hyaline; lodicules 2, ca. 0.2 mm long, conduplicate, hyaline; stamens 3, the anthers 1.8–2 mm long; stigma plumose, emerging at the apex. *Caryopsis* obovoid, 1.3–1.5 × 0.6–0.7 mm, brownish; hilum punctiform, basal; embryo less than 1/2 the length of the caryopsis.

Paratype. BRAZIL. **Goiás:** Mun. Niquelândia, 14°25′S, 48°26′W, margem da estrada entre Niquelândia e Macedo, cerradão próximo à mata ciliar, ca. 10 km N Niquelândia, estrada para Macedo, 20 maio 1993, *Filgueiras 2477* (IBGE, SI).

Observations. The winged rachis, and the pilose, hyaline spikelets, with an upper anthecium gaping at the apex are characteristics that clearly place this species within subgenus *Ceresia* (Chase, 1929). Within *Ceresia, Paspalum burmanii* is morphologically related to several species, including the following: *P. humboldtianum* Flüggé, which differs by its smaller plants, 30–90 cm tall, with thin, arcuate rhizomes; culms profusely branching; blades 5–21 cm long and 0.5–1.8 cm wide; inflorescences shorter, with 2 to 6 branches, the branch axis (rachis) narrower, 1.2–1.5 mm wide, lower lemma 3-nerved, the adaxial surface corrugated on the lower portion. *Paspalum buchtienii* Hackel, a species closely related to *P. humboldtianum*, differs from *P. burmanii* by (besides the other characters already indicated for *P. humboldtianum*) its drooping racemes and the rachis of the racemes 0.8–1.2 mm wide. *Paspalum humboldtianum* is found along the Andes, from Mexico to Bolivia and Argentina (Tovar, 1993; Renvoize, 1998; Zuloaga et al., 1994; Zuloaga & Morrone, 1999), whereas *P. buchtienii* is restricted to the Andean region in Bolivia (Renvoize, 1998) and southern Peru (Tovar, 1993).

Paspalum phyllorachis Hackel, another rare species of subgenus *Ceresia* also found in central Brazil, can be easily separated from *P. burmanii* by the lignified, bambusiform, and leaning culms that reach up to 5 m in height, blades 8–16 cm long, the rachis of the racemes 4–6 mm wide, the glabrous spikelets smaller, 2.1–2.4 mm long, and the upper anthecium 2 mm long.

Paspalum petrense A. G. Burman, another related, Brazilian species in subgenus *Ceresia*, originally described from Serra dos Pireneus (Burman, 1980), situated some 200 km from Niquelândia, was recently discovered by the senior author in an area near where *P. burmanii* was collected. *Paspalum petrense* differs by the fewer number of racemes (3 to 5), a wider inflorescence rachis (7–10 mm wide), spikelets obliquely set on the pedicels, and an upper lemma with a tuft of colorless hairs at the tip.

KEY TO DISTINGUISH *P. BURMANII* FROM RELATED SPECIES OF *PASPALUM* SUBG. *CERESIA*

1. Rachis of the racemes (4–)5–10 mm wide; spikelets obliquely placed on the pedicels; margins of the upper glume hyaline 2
1′. Rachis of the racemes 1–2.5(–3) mm wide; spikelets straight on the pedicels; margins of the upper glume becoming thick and corky at maturity 5
2(1). Spikelets solitary . . . . . *P. heterotrichon*
2′. Spikelets paired 3
3(2). Spikelets glabrous; plants with lignified, bambusoid culms . . . . . *P. phyllorhachis*
3′. Spikelets pilose; plants herbaceous, the culms neither lignified nor bambusoid 4
4(3). Rachis 7–10 mm wide; culms erect . . *P. petrense*
4′. Rachis 4–6 mm wide; culms leaning on vegetation . . . . . *P. trachycoleon*
5(1). Blades linear to linear-lanceolate, 4–13 cm long, 0.1–0.2(–0.5) cm wide; upper glume with unequal hairs, not radiating as in a corona; lower lemma pilose toward the apex *P. polyphyllum*
5′. Blades lanceolate, 5–35 cm long, 0.5–1.8 cm wide; upper glume with a fringe of glistening white hairs, the hairs even and radiating as in a corona; lower lemma with glabrous margins 6
6(5). Inflorescences drooping, lower branches with rachis 0.8–1.2 mm wide; spikelets 0.8–1 mm wide; blades shortly pseudopetiolate, papyraceous . . . . . *P. buchtienii*
6′. Inflorescences ascending, lower branches with rachis 1.2–3 mm wide; spikelets 1.2–1.4 mm wide; blades not pseudopetiolate, membranous 7
7(6). Plants 150–200 cm tall; inflorescences 20–25 cm long, 7–12 cm wide; branches 7 to 11, rachis of the racemes 2.8–3 mm wide; lower lemma 5-nerved, scaberulous, not corrugate . . *P. burmanii*
7′. Plants 30–50(–90) cm tall; inflorescences 8–12 cm long, 3–5 cm wide; branches 2 to 6, rachis of the racemes 1.2–1.5 mm wide; lower lemma 3-nerved, scaberulous toward the apex, otherwise glabrous, corrugate . . . . . *P. humboldtianum*

Distribution and ecology. The new species was found growing at the edge of a cerradão, i.e., a tall woodland variant type of cerrado (Eiten, 1972) near Macedo, in the municipality of Niquelândia. The plants grew in large clumps and appeared rather robust and healthy, despite the fact that dust from a nearby unpaved road covered most of their leaves.

The site where this colony grew is under intense human activity, since the road nearby was recently expanded at the expense of this population. A single colony was found, but this had more than 100

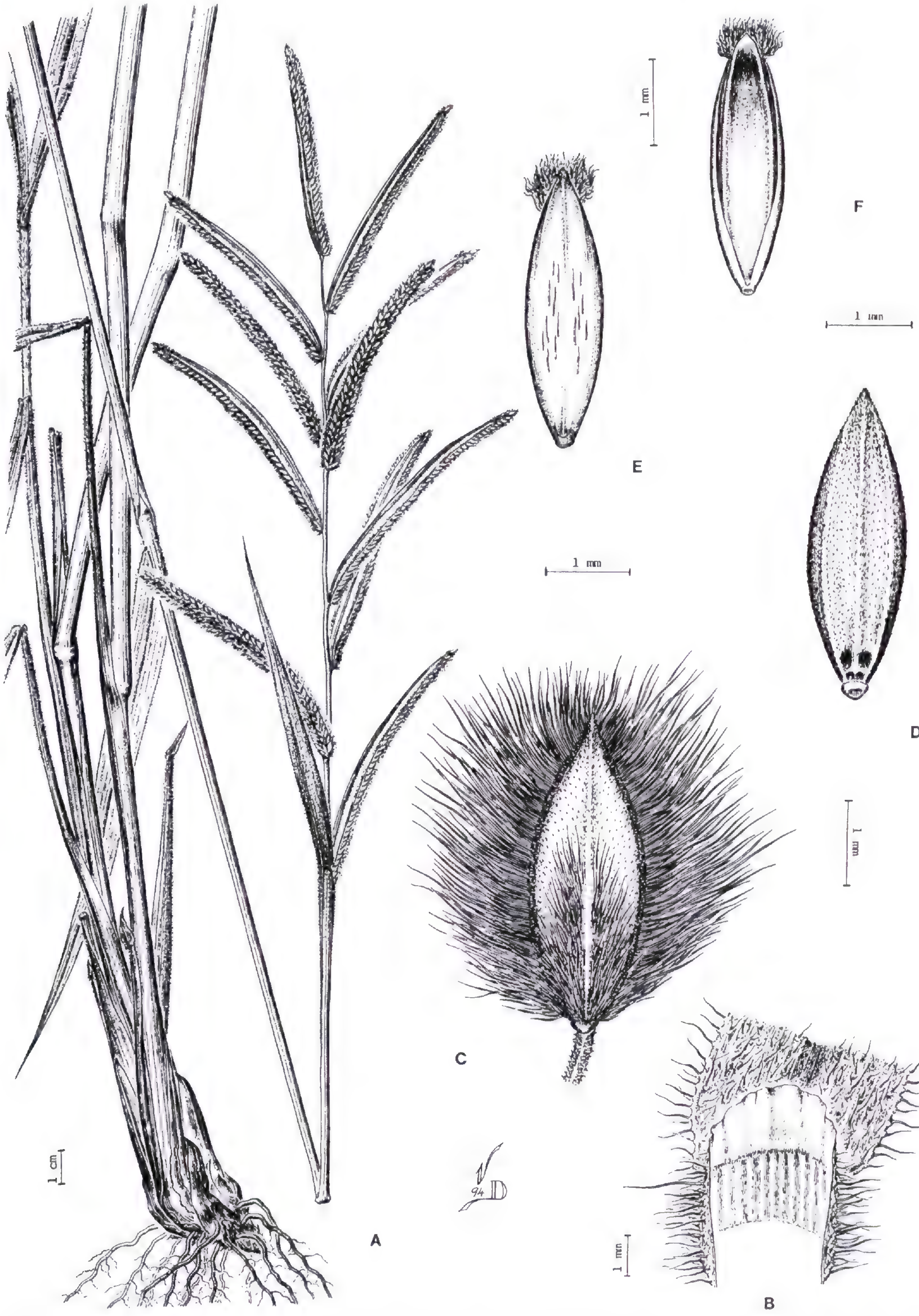


Figure 1. *Paspalum burmanii* Filgueiras, Morrone & Zuloaga. —A. Habit. —B. Detail of ligule. —C. Spikelet, dorsal view showing upper glume. —D. Lower lemma. —E. Upper anthecium, dorsal view. —F. Upper anthecium, ventral view (based on the type, *Filgueiras 2471*).

clumps. It is noteworthy that around 300–500 m away, there is a serpentine outcrop called "Fonte da Bica," where the serpentine endemic grass genus and species *Ophiochloa hydrolithica* Filgueiras et al. was collected (Filgueiras et al., 1993). So, although we cannot state that *P. burmanii* grows on serpentine soil, like other species of *Paspalum* recently described from Niquelândia (see Davidse & Filgueiras, 1993; Filgueiras & Davidse, 1994; Filgueiras et al., 1993; Filgueiras, 1995), it certainly grows in an area of serpentine influence.

The serpentine outcrops in the municipality of Niquelândia have yielded a remarkable wealth of new Poaceae, especially in the genus *Paspalum*. The first species described from the area was *P. longiaristatum* Davidse & Filgueiras (Davidse & Filgueiras, 1993), followed by *P. biaristatum* Filgueiras & Davidse (Filgueiras & Davidse, 1994), and *P. niquelandiae* Filgueiras (Filgueiras, 1995).

Taxa in the serpentine outcrops in Niquelândia face a bleak future. As of now no conservation unit of any sort exists in the state of Goiás or anywhere else in Brazil that can offer legal protection to the plant species from these outcrops. The land where all these serpentine and serpentine-related species grow belongs to a private mining company (Companhia de Níquel Tocantins) that maintains an active plant in the area, with three working shifts. If a conservation campaign is not launched soon to convince the land owners to set aside representative samples of the serpentine outcrops as permanent conservation areas, there is little hope for the survival of any of these species.

There is some hope, however. In a recent workshop held in Brasília, the capital of Brazil, under the auspices of the Brazilian Ministry of the Environment, three NGOs (non-governmental organizations), and the University of Brasília addressed conservation issues in the cerrado region. Eighty-seven areas were selected for special conservation efforts. Due to the efforts of a few dedicated botanists present at the workshop, Niquelândia was one of the sites selected for special conservation efforts (BRASIL, 1999).

The specific epithet commemorates our late friend and collaborator Alasdair G. Burman, an expert on Brazilian grasses, especially the genus *Paspalum*. Before his sudden and premature death in 1992, Alasdair was preparing a revision of subgenus *Ceresia* and had a chance to examine the specimens that were used here to describe *P. burmanii*. It is fitting that we also honor here Alasdair's widow, Laura Burman, and son, Nickolas Burman.

Acknowledgments. We thank Vladimiro Dudás for preparing the excellent illustration and the staff of Reserva Ecológica do IBGE for suppport, especially Marina Fonseca, Francisco das Chagas Oliveira, and Roberta C. de Mendonça. The senior author thanks the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for a research grant (Process nr. 301190/86-0).

Literature Cited

BRASIL. Ministério do Meio Ambiente [dos Recursos Hídricos e da Amazônia Legal]. 1999. Ações prioritárias para a conservação da biodiversidade do Cerrado e Pantanal. Brasília: Ministério do Meio Ambiente/FUNATURA/Conservation International/Fundação Biodiveristas/Universidade de Brasília.

Burman, A. B. 1980. A new species of *Paspalum* (Gramineae) from Brazil. Kew Bull. 35: 297–298.

Chase, A. 1929. The North American species of *Paspalum*. Contr. U.S. Natl. Herb. 28: 1–310.

Davidse, G. & T. S. Filgueiras. 1993. *Paspalum longiaristatum* (Poaceae: Paniceae), a new serpentine endemic from Goiás, and the first awned species in the genus. Novon 3: 129–132.

Eiten, G. 1972. The cerrado vegetation of Brazil. Bot. Rev. 38: 201–341.

Filgueiras, T. S. 1995. *Paspalum niquelandiae* (Poaceae: Paniceae), a new species from serpentine outcrops of central Brazil. Novon 5: 30–33.

——— & G. Davidse. 1994. *Paspalum biaristatum* (Poaceae: Paniceae), a new serpentine endemic from Goiás, Brazil, and the second awned species in the genus. Novon 4: 18–22.

———, ——— & F. O. Zuloaga. 1993. *Ophiochloa*, a new endemic serpentine grass genus (Poaceae: Paniceae) from the Brazilian cerrado vegetation. Novon 3: 310–317.

Renvoize, S. A. 1998. Gramíneas de Bolivia. Royal Botanic Gardens, Kew.

Tovar, O. 1993. Las gramíneas (Poaceae) del Perú. Ruizia 13: 347–378.

Zuloaga, F. O. & O. Morrone. 1999. Subfamilia Panicoideae. *In:* P. M. Jørgensen & S. León-Yanez (editors), Catalogue of the Vascular Plants of Ecuador. Monogr. Syst. Bot. Missouri Bot. Gard. 75: 806–838.

———, E. G. Nicora, Z. E. Rúgolo de Agrasar, O. Morrone, J. Pensiero & A. M. Cialdella. 1994. Catálogo de la familia Poaceae en la República Argentina. Monogr. Syst. Bot. Missouri Bot. Gard. 47: 1–178.

A New Species of *Encholirium* (Bromeliaceae) from Minas Gerais, Brazil

Rafaela Campostrini Forzza
Departamento de Botânica, Instituto de Biociências, Universidade de São Paulo, C.P. 11461, 05422-970, São Paulo, SP, Brazil

Maria das Graças L. Wanderley
Instituto de Botânica de São Paulo, C.P. 4005, 01061-970, São Paulo, SP, Brazil

ABSTRACT. A new species of *Encholirium* from the campos rupestres of Minas Gerais, Brazil, is described and illustrated. *Encholirium reflexum* is a distinctive taxon characterized by reflexed leaves, imbricate petals and sepals, as well as style and stamens included in the corolla tube. The most closely related species is *E. pedicellatum* (Mez) Rauh, which can be distinguished by its higher number of leaves per rosette, flowers with short pedicels, and suborbicular and imbricate sepals.

RESUMO. Uma nova espécie de *Encholirium* procedente dos campos rupestres de Minas Gerais, Brasil é descrita e ilustrada. *Encholirium reflexum* caracteriza-se por apresentar folhas reflexas, pétalas e sépalas imbricadas, estames e estilete inclusos no tubo da corola. Difere de *E. pedicellatum* (Mez) Rauh por possuir um número muito maior de folhas por roseta, pelas flores com pedicelos reduzidos e sépalas suborbiculares e imbricadas.

Key words: Brazil, Bromeliaceae, *Encholirium*, Pitcairnioideae.

The genus *Encholirium* Martius ex Schultes & Schultes f. belongs to the bromelid subfamily Pitcairnioideae and includes ca. 31 species (Smith & Read, 1989). It is restricted to southeast, northeast, and central Brazil, where it forms large populations on rock outcrops. The genus is widely spread in the Brazilian campos rupestres of Minas Gerais. *Encholirium* is closely related to *Dyckia* Schultes & Schultes f., from which it differs by the terminal scape and free stamens (Forzza & Wanderley, 1998).

Encholirium reflexum Forzza & Wanderley, sp. nov. TYPE: Brazil. Minas Gerais: Município de Rio Pardo de Minas, Serra do Deus Me Livre, 15°58′S, 42°49′W, May 1998 (fl), *R. C. Forzza, J. R. Pirani, A. C. Marcato, M. C. Assis & P. H. Labiak 800* (holotype, SPF; isotypes, BHCB, US).

Ab omnibus speciebus generis foliis reflexis, dense lepidotis, cinereis, bracteis superis scapi brevioribus quam internodis, inflorescentia simplici et laxa, bractis floralibus brevioribus quam floribus, pedicellis brevibus, 3–4 mm longis, sepalis suborbicularibus, imbricatis, petalis oblongo-orbicularibus, imbricatis, staminibus inclusis differt.

Plants 0.6–1.0 m long, saxicolous. Rhizomes short. Rosettes 15–30 cm diam. Leaves reflexed; sheaths 4.2–6.0 × 1.8–2.5 cm, margin entire; leaf blades 13–24 × 1.5–2.7 cm, lanceolate, grayish, rarely reddish, densely lepidote, margins spinose; spines 4–7 mm long, spreading or retrorse. Scape 45–62 cm long, 0.8–1.0 cm diam., terminal, green, erect, glabrous. Lower scape bracts exceeding or same length as the internodes, 6–10 cm long, erect; the upper scape bracts shorter than the internodes, 1.7–2.6 cm long, lanceolate, stramineous, apex acute to attenuate, entire, glabrous, clasping the scape. Inflorescence 22–33 cm long, raceme, simple, laxly few-flowered, 32–75 flowers; rachis green, glabrous. Pedicels 3–4 mm long, green, cylindric, glabrous. Floral bracts shorter than the flowers, 1.1–1.5 × 0.4–0.5 cm, castaneous, lanceolate, apex attenuate, margin entire, glabrous. Flowers spreading; sepals 5–7 × 5–7 mm, green, imbricate, symmetric, suborbicular, apex rounded or inconspicuously pointed, glabrous; petals 7–9 × 7.0–9 mm, green, imbricate, oblong-orbicular, apex rounded, glabrous; stamens 1.0–1.1 cm long, free, included, or with anthers only slightly exserted; anthers connivent, apiculate; ovary 5–6 mm long, green; style ca. 4.0 mm long, green, included. Capsules 1.1–1.8 cm long, perianth persistent. Seeds ca. 3 cm long, alate.

Encholirium reflexum presents a peculiar habit, with reflexed leaves (Fig. 1A) that are completely covered by scales, giving the blade an intense grayish color. The flowers are distinctive, with suborbicular sepals, imbricate petals, and nearly included stamens (Fig. 1B).

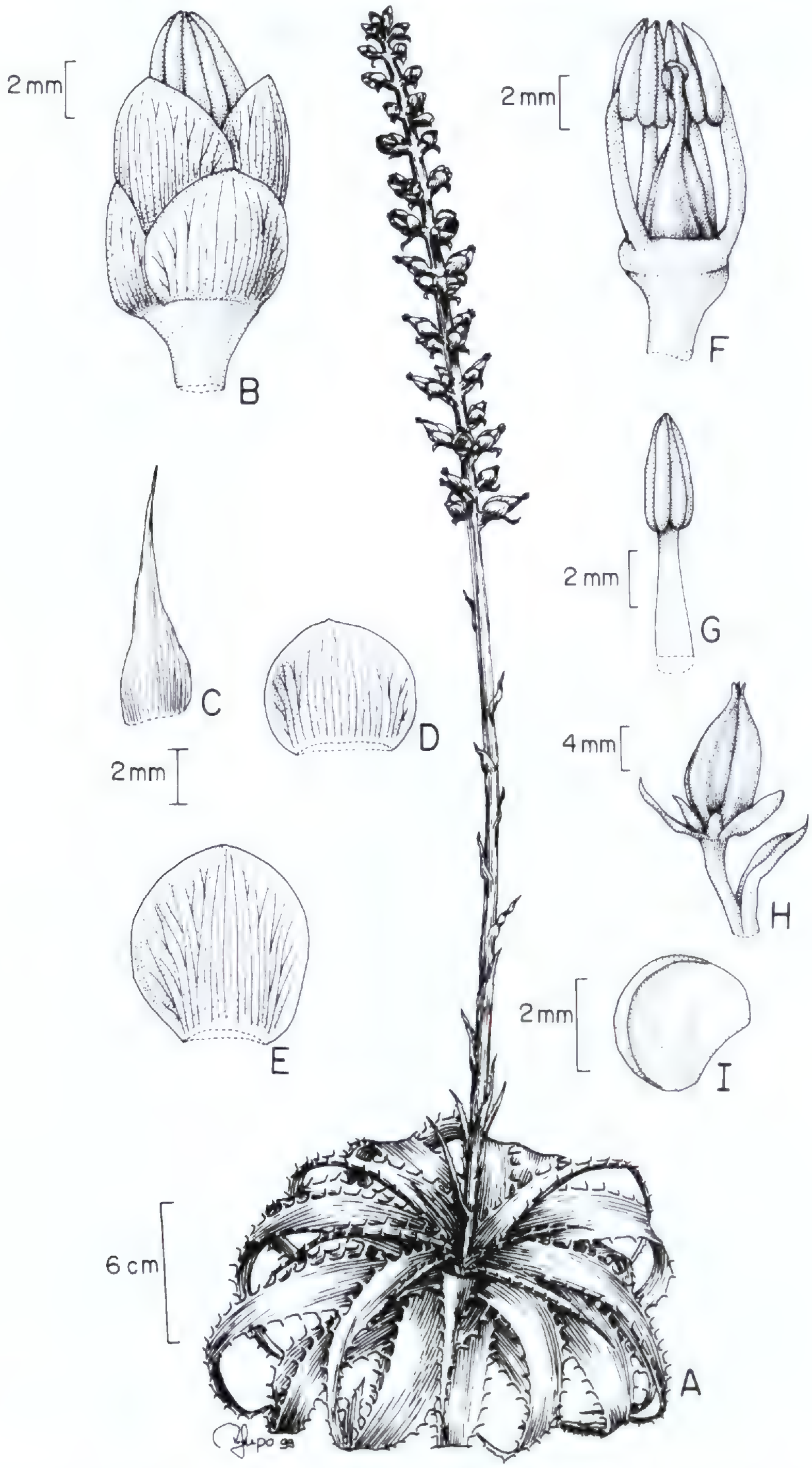


Figure 1. *Encholirium reflexum* Forzza & Wanderley. —A. Habit. —B. Flower. —C. Floral bract. —D. Sepal. —E. Petal. —F. Stamens and gynoecium. —G. Stamen. —H. Capsule. —I. Seed. Drawings based on *R. C. Forzza et al. 800* (A–G) and *R. C. Forzza et al. 538* (H, I).

According to Rauh (1987), the presence of imbricate petals and relatively long pedicels, segregate a "*longipedicellatum*" group within *Encholirium*. This group is made up of five species, all of which are restricted to the campos rupestres vegetation in Minas Gerais, Brazil, and are short when compared to the other species of the genus (Rauh, 1987). However, *E. vogelii* Rauh is over 1.5 m tall,

and *E. reflexum* has short pedicels (Fig. 1B), so apparently plant height and pedicel size vary within this group. On the other hand, the combination of imbricate petals as well as stamens and stigma included within the corolla are constant characters for the "*longipedicellatum*" group, differing from other *Encholirium* species, which have non-imbricate petals and exserted stamens.

Paratypes. BRAZIL. **Minas Gerais:** Município de Diamantina, Estrada Diamantina–Milho Verde, Dec. 1997 (fr), *R. C. Forzza, P. T. Sano, N. Roque, A. C. Marcato & L. R. Lima 538* (MO, SPF); 15 km SE de Diamantina, caminho a Milho Verde, ca. 18°20′S, 43°33′W, Feb. 1991 (fr), *M. M. Arbo, N. L. Menezes, A. Schinini & M. T. V. A. Campos 5145* (CTES, SPF, US).

Acknowledgments. The authors are grateful to Simon Mayo and Cintia Kameyama for corrections and critical comments, Rogério Lupo for preparing the illustration, and FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) for financial support.

Literature Cited

Forzza, R. C. & M. G. L. Wanderley. 1998. Flora da Serra do Cipó, Minas Gerais: Bromeliaceae–Pitcairnioideae. Bol. Bot. Univ. São Paulo 17: 255–270.

Rauh, W. 1987. Bromelienstudien. Trop. Subtrop. Pflanzenwelt 60: 907–1004.

Smith, L. B. & R. W. Read. 1989. Flora Neotropica Monograph 14(1), supplement *Encholirium*. Bradea 5(27): 291–312.

New Names in African Celastraceae and Rutaceae

Roy E. Gereau
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. *Maytenus masindei* Gereau (Celastraceae) and *Vepris hiernii* Gereau (Rutaceae) are published as avowed substitutes (replacement names) for *Maytenus conferta* Masinde ex N. Robson and *Cranzia angolensis* Hiern.

Key words: Africa, Celastraceae, *Cranzia*, *Maytenus*, Rutaceae, *Vepris*.

Although Loesener (1892: 206) failed to provide full and direct reference to a basionym when he published the combination *Maytenus conferta* (Ruiz & Pavón) Reissek ex Loesener (Celastraceae), the citation of "*Celastrus* Ruiz & Pav., Baill. pr. Parte" in the synonymy of *Maytenus* on the preceding page and the parenthetical citation of "Ruiz et Pav." in the new combination constitute an indirect reference to the basionym *Celastrus confertus* Ruiz & Pavón (Fl. peruv. 3: 7. 1802) and satisfy the requirements of the ICBN Article 32.4 (Greuter et al., 2000: 54). The combination was never listed in *Index Kewensis*, although Macbride (1951: 263) and Liesner (1993: 344) used this name for a species occuring in Peru and Bolivia. The recently published name for a species from East Africa is a later homonym of this combination and thus requires an avowed substitute (replacement name).

Maytenus masindei Gereau, nom. nov. Replaced name: *Maytenus conferta* Masinde ex N. Robson, Fl. Trop. E. Africa (Celastraceae): 16. 1994, nom. illeg. Not *M. conferta* (Ruiz & Pavón) Reissek ex Loesener, Nat. Pflanzenfam. 3(5): 206. 1892. TYPE: Kenya. Kilifi Dist., Marafa, *Luke & Robertson 2498* (holotype, EA not seen; isotypes, K not seen, MO).

Robson (1994: 16) ascribed the name *Maytenus conferta* solely to Masinde, but with no indication that Masinde provided the description; as in the ICBN Article 46.4, Ex. 17 and 18 (Greuter et al., 2000: 73), the name must be attributed to Masinde ex N. Robson. *Maytenus masindei* is a species endemic to coastal Kenya and Tanzania, distinguished from *M. heterophylla* (Ecklon & Zeyher) N. Robson by thickly coriaceous capsules, very short, few-flowered pistillate inflorescences, and usually small, crowded, coriaceous subsessile leaves.

Mziray (1992: 68) included *Diphasia* Pierre in the synonymy of *Vepris* Commerson ex A. Jussieu (Rutaceae). *Crainzia angolensis* Hiern was long treated as *Diphasia angolensis* (Hiern) I. Verdoorn (e.g., Gilbert, 1958: 106). Due to the prior publication of *Vepris angolensis* Engler, an avowed substitute (replacement name) is required to treat *Crainzia angolensis* as a species of *Vepris*.

Vepris hiernii Gereau, nom. nov. Replaced name: *Crainzia angolensis* Hiern, Cat. afr. pl. 1: 115. 1896; *Diphasia angolensis* (Hiern) I. Verdoorn, Kew Bull. 1926: 411. 1926; *Vepris angolensis* (Hiern ['Verdoorn']) Mziray, Symb. Bot. Upsal. 30(1): 70. 1992, nom. illeg. Not *Vepris angolensis* Engler, Nat. Pflanzenfam. 3(4): 178. 1896; *Fagaropsis angolensis* (Engler) Dale, Trees and Shrubs of Kenya 99. 1936. TYPE: Angola. Cuanza Norte, Golungo Alto, Sobado de Bumba, rio Quiapoza, *Welwitsch 4552* (holotype, BM not seen; isotype, LISU not seen).

Vepris hiernii is a shrub or small tree distributed in gallery forests of Angola, Gabon, and Democratic Republic of Congo, distinguished from other species of *Vepris* in those countries by an isostemonous androecium and bilocular ovary (diagnostic characters of *Diphasia*).

Literature Cited

Gilbert, G. 1958. Rutaceae. *In*: Comité exécutif de la Flore du Congo belge, Flore du Conge belge et du Ruanda-Urundi 7: 69–108, Institut national pour l'étude agronomique du Congo belge, Brussels.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth. 2000. International Code of Botanical Nomenclature. Regnum Veg. 138: i–xviii, 1–474.

Liesner, R. L. 1993. Celastraceae. *In* L. Brako & J. L. Zarucchi, Catalogue of the Flowering Plants and Gymnosperms of Peru. Monogr. Syst. Bot. Missouri Bot. Gard. 45: 344–345.

Loesener, T. 1892. Celastraceae. *In*: A. Engler & K. Prantl (editors), Die natürlichen Pflanzenfamilien 3(5): 189–222, Wilhelm Engelmann, Leipzig.

Macbride, J. F. 1951. Celastraceae. *In:* J. F. Macbride, Flora of Peru. Field Mus. Nat. Hist., Bot. Ser. 13(3A): 259–270.

Mziray, W. 1992. Taxonomic studies in Toddalieae Hook. f. (Rutaceae) in Africa. Symb. Bot. Upsal. 30(1): 1–95.

Robson, N. K. B. 1994. *Maytenus*. Pp. 3–20 *in* N. K. B. Robson, N. Hallé, B. Mathew & R. Blakelock, Celastraceae. *In* R. M. Polhill (editor), Flora of Tropical East Africa. A. A. Balkema, Rotterdam.

Eleocharis aestuum (Cyperaceae), a New Tidal River Shore Spikesedge of the Eastern United States

Arthur Haines

Woodlot Alternatives, Inc., 122 Main Street, Number 3, Topsham, Maine 04086, U.S.A.
ahaines@woodlotalt.com

ABSTRACT. *Eleocharis diandra* is an annual spikesedge of northeastern U.S. river and lake shores. This species has a complicated taxonomic history and has been included in the synonymy of other members of the *Eleocharis ovata* complex by various researchers. Its differing applications are due, in part, to the existence of a previously undescribed taxon. The new species *Eleocharis aestuum* is described from the eastern United States and is restricted to freshwater tidal river communities. This species is similar to *E. diandra* in its marked absence or reduction of perianth bristles, but it differs in floral scale and tubercle morphology. Despite limited regional variation in morphology, *E. aestuum* is morphologically separable from other spikesedges throughout its range. Recognition of this new species reveals that *E. diandra* is geographically restricted and globally imperiled. Conservation action is needed for both species.

Key words: Cyperaceae, *Eleocharis*, North America, United States.

The *Eleocharis ovata* (Roth) Roemer & Schultes complex in North America is comprised of a small group of short-statured annuals that occur in a wide variety of open wetland communities. These caespitose species possess white to brown, smooth, biconvex achenes, dark brown and compressed tubercles, and a base chomosome number of $n = 5$ (Hines, 1975). Species of this group do not display obvious vegetative differences between one another. Identification is based primarily on style and stamen number and achene, floral scale, and spikelet morphology. In need of clarification, spikesedges of Atlantic tidal river shores have suffered from taxonomic confusion.

Careful review of herbarium material reveals a new species with reduced or obsolete perianth bristles, similar to *Eleocharis diandra* C. Wright, but with larger tubercles (mostly 0.2–0.3 × 0.35–0.46 mm), white-brown to nearly colorless floral scales that are rounded and not keeled at the apex, and commonly ellipsoid spikes (Fig. 1). This plant is restricted to fresh tidal river shores of the eastern United States. In contrast, the related and wide-ranging *E. obtusa* (Willdenow) Schultes occurs in a wide variety of habitats including river and lake shores, wet depressions, and ditches. Publication of this new spikesedge is needed for the upcoming Cyperaceae treatment in the *Flora of North America*.

Eleocharis aestuum D. M. Hines ex A. Haines, sp. nov. TYPE: U.S.A. New York: Columbia County, Livingston, intertidal mud, north shore, inlet, Roeliff Jansen Kill, 7 Aug. 1968, *Hines 6826A* (holotype, MICH).

Culmi 3.0–30.0 cm longi, 0.5–1.0 mm lati; spicae 3.0–10.0 mm longae, 2.0–4.0 mm latae, pallidae, ellipsoideae vel ovoideae; squamae florales apice rotundato, pallidae, costa viridi; flos perianthii setis nullis vel presentibus, 2–4, acheniis brevioribus; stamina 2(3); antherae 0.25–0.5 mm longae; styli bifidi (trifidi); achenia 0.75–1.00 mm longa, 0.58–0.78 mm lata; tubercula 0.20–0.30 mm longa, 0.35–0.46(–0.55) mm lata.

Stems 3.0–30.0 × 0.05–0.1 cm; leaf sheath 5.0–35.0 mm long, the apex truncate to oblique, usually darkened, and somewhat thickened, also sometimes provided with a small point; spikelets 3.0–10.0 × 2.0–4.0 mm, pale, ellipsoid to ovoid; floral scales covering the achenes, usually thin and scarious, rounded at the apex, white, sometimes tinged with brown, usually with a green midrib; perianth bristles absent or present, when present numbering 2–4, 0.1–0.6 mm long, lacking minute, retrorse barbules, and up to 0.4 times as long as the body of the achene; stamens 2(3); anthers 0.25–0.5 mm long; styles bifid (trifid); achenes white to light brown, the body 0.75–1.00 × 0.58–0.78 mm, biconvex in cross section; tubercles triangular, compressed, dark brown, 0.2–0.3 × 0.35–0.46(–0.55) mm, 0.50–0.68(–0.80) times as wide as the achene.

Eleocharis diandra occurs on wet sand shores of lakes and rivers of the northeastern United States subject to inundation in early season and other high water events. Though *E. diandra* sometimes occurs on shores of fresh tidal rivers, it is found in areas with minimal tidal fluctuation. It was described by

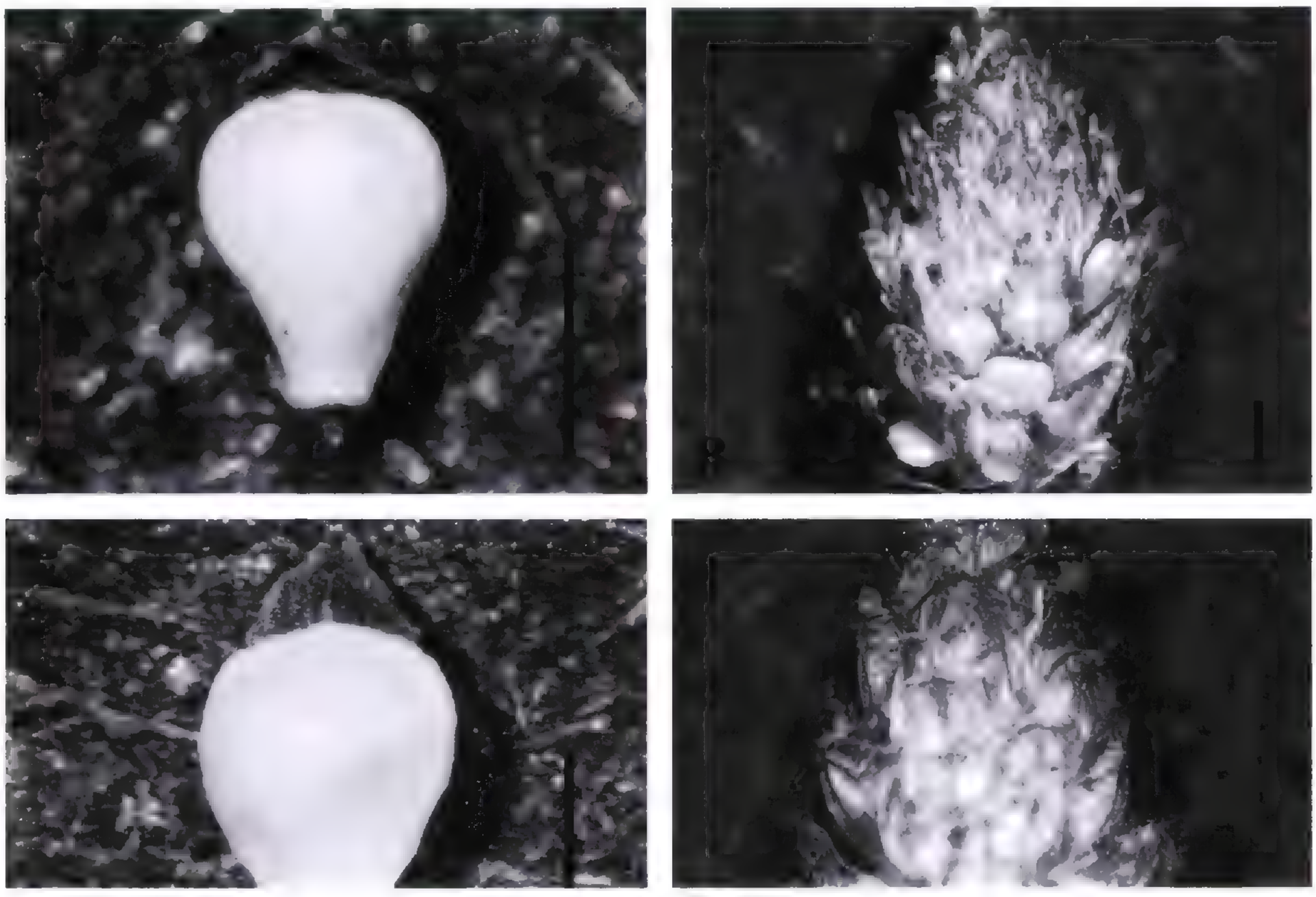


Figure 1. Achenes and spikelets of *Eleocharis diandra* and *E. aestuum*, bar = 0.5 mm. —A. *E. diandra* (*Wright 1880*, GH). —B. *E. diandra* (*Wright 1881*, GH). —C. *E. pallidostachys* (*Fernald & Long 12786*, GH). —D. *E. aestuum* (*Fernald & Long 12786*, GH).

Wright (1883) from the Connecticut River in Connecticut. This species has been included in the synonymy of *E. ovata* (Svenson, 1939, 1953; Gleason & Cronquist, 1991) and *E. obtusa* (Svenson, 1957; Kartesz, 1994). *Eleocharis diandra* is, however, one of the most distinctive species of this complex (Fig. 1). It has purple-brown floral scales that are acute and somewhat keeled at the apex (particularly in drying), similar to the southeastern *E. lanceolata* Fernald. The achenes lack perianth bristles and are crowned by diminutive tubercles (0.10–0.20 × 0.24–0.46 mm). The fruits are borne in plump, ovoid spikes. Fernald's (1950) description of *E. diandra*, however, depicts a different plant. Though tubercle and perianth bristle character states conform to the type, the floral scales are described as pale and rounded at the apex. Confusion of its identity is, in part, due to the existence of the previously undescribed *E. aestuum*.

Eleocharis aestuum was first identified as a distinct taxon by David Hines (1975), who considered it closely related to *E. diandra*. It most closely resembles *E. ovata*, however, and is consistently separated from this species only on the basis of its diminutive perianth bristles and pale floral scale color. *Eleocharis aestuum* appears to be similar to tidal species of *Bolboschoenus* and *Schoenoplectus* in that reduction or complete absence of perianth bristles is correlated with existence in tidal communities (Schuyler, 1972; Strong, 1994).

Hines (1975) applied the name *Eleocharis pallidostachys* to *E. aestuum* in his dissertation and on sheet determinations. This name was not validly published according to the *Saint Louis Code* (Greuter et al., 2000), Article 29 and Recommendation 30A. The epithet *pallidostachys* is further disallowed by its mixture of Latin and Greek roots (Rec. 23A.3c). I have instead chosen the specific epithet *aestuum*, which means tidal, reflecting the associated habitat of the new species.

Many researchers failed to identify the distinctiveness of *Eleocharis aestuum* from *E. diandra*, despite the fact that these two species share only the similarity of reduced or obsolete perianth bristles. Svenson (1939) considered *E. aestuum* (under the name *E. diandra*) as conspecific with *E. ovata* after observing plants from the Hudson River with perianth bristles. However, the perianth bristles of these *E. aestuum* plants are reduced in length (shorter than the body of the achene) and smooth. In comparison, the perianth bristles of *E. ovata* exceed the combined length of the achene body and tubercle and are minutely retrose-barbulate.

Svenson (1953) later discussed specific collections from the Hudson River where he described a gradation between *E. aestuum* (as *E. diandra*) and

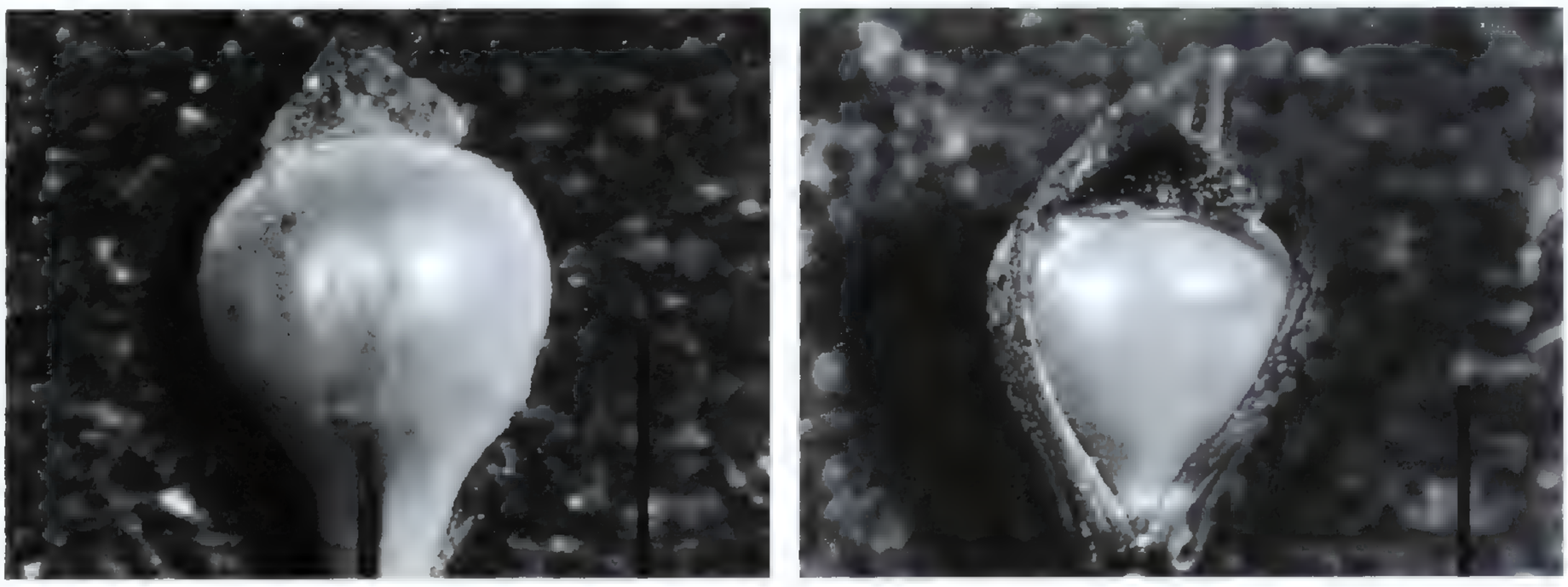


Figure 2. Achenes of *Eleocharis aestuum* and *E. obtusa*, bar = 0.5 mm. —A. *E. aestuum* (*Svenson 13050b*, MICH). —B. *E. obtusa* (*Merrill 1898*, MAINE).

E. obtusa. Later examination of those specimens (*Svenson 13050a, b*, and *c*, MICH) by Hines (1975) and myself do not reveal morphological intermediates. *Eleocharis aestuum* can be reliably separated from *E. obtusa* in the Hudson River valley on the basis of reduced perianth bristles, pale floral scales, narrower tubercles, and two styles and stamens per flower (Fig. 2).

Hines (1975) considered *Eleocharis aestuum* to be a species that could, in rare instances, possess well-developed perianth bristles. This interpretation is based on a set of extremely rare plants that are known only from the Delaware River (e.g., *Ferren 796* (PH), *Ferren 712* (PH), *Ferren 1096* (PH), *Benner 3747* (PH)). These specimens are a mixture of *E. obtusa* and *E. ovata* collections taken from fresh tidal communities. Similar to *E. aestuum*, they have relatively pale floral scales. However, these plants all possess long perianth bristles with retrorse barbules. Furthermore, close examination of many of the spikes reveals a sharp, but limited region of red-purple coloration on the floral scales. Therefore, these plants are excluded from the concept of *E. aestuum*.

Through examination of specimens from east coast tidal rivers, including four populations known to occur with or in close vicinity to other members of the *Eleocharis ovata* complex, and common garden experiments performed by Hines (1975), it is clear that *E. aestuum* is a distinct species that maintains its identity rangewide. Additionally, *E. aestuum* possesses a chromosome number of $2n = 10$, similar to all other species of the *E. ovata* complex in North America (Hines, 1975). With the proposed taxonomic innovations, *Eleocharis aestuum* and *E. diandra* are species of conservation concern (G3 and G2, respectively). Most occurrences of these two species are historic (collected prior to 1975). Furthermore, many collections are from rivers that are now influenced by shoreline development, pollution, and river flow alteration (e.g., Delaware River, Connecticut River, Merrimack River). The only recent observations of *E. aestuum* are from the Androscoggin and the Kennebec Rivers (Maine) and the Hudson River (New York), and these populations consist of eight plants or fewer (A. Haines, unpublished). For *E. diandra*, the only recent observations are from the Connecticut River (Massachusetts) and Oneida Lake (New York), and these populations consist of five plants or less (A. Haines, unpublished).

Eleocharis aestuum usually occurs on wet sand, silt, or mud of fresh tidal rivers near or below the high tide limit. Where *E. aestuum* and *E. diandra* occur on the same river (e.g., Connecticut River), *E. aestuum* occurs further downstream where tidal fluctuation has a relatively greater effect on the plant communities. *Eleocharis aestuum* occurs with other fresh tidal species such as *Eriocaulon parkeri* B. L. Robinson, *Lindernia dubia* (L.) Pennell, *Persicaria punctata* (Elliott) Small, *Schoenoplectus smithii* (A. Gray) Soják, and *Schoenoplectus pungens* (Vahl) Palla.

Paratypes. U.S.A. **Connecticut:** Lyme, shore at Silden's Cove, 6 Sep. 1911, *Harger 6107* (GH). **Delaware:** Wilmington, bank of Christiana River opposite mouth of White Clay Creek, 28 Sep. 1972, *Ferren & Schuyler 1153* (PH). **Maine:** mud flats, Androscoggin River, 26 Aug. 1911, *Bissell s.n.* (MAINE); Bowdoinham, tidal mud flats, 16 Aug. 1968, *Hines 6835k* (MO). **New Jersey:** Kinkora, muddy tidal shore, Delaware River, 10 Aug. 1914, *Long 10757* (PH). **Pennsylvania:** Tullytown, tidal shore, Delaware River, 6 Sep. 1927, *Long 33775* (PH).

Other representative specimens examined. **Eleocharis aestuum.** U.S.A. **Connecticut:** Lyme, shore at Silden's Cove, 6 Sep. 1911, *Harger 6107* (GH). **Delaware:** Hollyoak, upper tidal zone of *Scirpus americanus*, Delaware River, 15 Sep. 1972, *Ferren 1115* (PH), 0.1 mi. NW of buoy light, 15 Sep. 1972, *Ferren 1109* (PH). **Maine:** Brunswick, 1 Aug. 1894, *Davis s.n.* (GH); Brunswick, W

shore of Kennebec River, 24 Aug. 1921, *Fassett 117* (GH); Gardiner, 17 Sep. 1923, *Fassett 1030* (GH); Bowdoinham, tidal mud flats, 16 Aug. 1968, *Hines 6835, l, m, n, o, p, q, r, s, t, u, v, w, x,* and *y* (MICH); Cathance River at Merrymeeting Bay, 3 Sep. 1964, *Rossbach 6229* (MAINE); Abagadassett River, 17 Aug. 1983, *Vickery s.n.* (MAINE); tidal mud flats, Cathance River, 14 and 19 Sep. 1916, *Fernald & Long 12786* (GH); Topsham, Pleasant Point, Merrymeeting Bay, 10 Oct. 1993, *Hall s.n.* (MAINE), 14 Sep. 1991, *Hall s.n.* (MAINE), 15 Sep. 1991, *Hall s.n.* (MAINE); mud flats, Androscoggin River, 26 Aug. 1911, *Bissell s.n.* (GH); Woolwich, Coffin Sanctuary, intertidal mudflats, *Vickery s.n.* (MAINE). **New Jersey:** Kinkora, muddy tidal shore, Delaware River, 10 Aug. 1914, *Long 10765* (PH), 13 Oct. 1914, *Long 10943, 10996* (PH); Palmyra, tidal shore of Delaware River, 24 Sep. 1971, *Ferren 796* (PH); S end Burlington Island, Delaware River, 25 July 1972, *Ferren & Lloyd 985* (PH); Delair, Delaware River shore, 24 July 1905, *Brown, Crawford & Van Pelt s.n.* (PH), 30 Sep. 1907, *Van Pelt & Long s.n.* (PH); National Park, tidal shore of tributary to Woodbury Creek, 16 July 1971, *Ferren 712* (PH); Delaware River, Raccoon Island, 1 Oct. 1971, *Ferren 814, 815* (PH); Duck Island, Delaware River below Trenton, 10 Sep. 1972, *Schuyler 4353* (PH); tidal flats, Raritan River, Oct. 1918, *Mackenzie s.n.* (PH). **New York:** Livingston, tidal estuary of Hudson River, Roelliff Jansen Kill, 14 Sep. 1950, *Svenson 13050b* and *c* (MICH), 7 Aug. 1968, *Hines 6826a* and *b* (MICH); Hudson, Hudson River, 30 Sep. 1923, *Svenson s.n.* (GH); Catskill, mouth of Catskill Creek, 4 Sep. 1936, *Muencher & Curtis 5651* (GH); Saugerties, tidal mud flats, Hudson River, 2 Sep. 1936, *Muenscher & Curtis 5649* (GH). **Pennsylvania:** Eddington, border of dredged sand over tidal marsh, Delaware River, 24 Sep. 1932, *Long 38557* (PH); tidal shores, Delaware River, 24 Sep. 1932, *Long 38535* (PH); Bristol, mouth of tidal stream, Delaware River, 6 Oct. 1971, *Ferren & Givens 821, 822* (PH); Croydon, Delaware River, 0.6 mi. NE of mouth of Neshaminy Creek, 12 Aug. 1971, *Ferren & Givens 727* (PH); Andalusia, muddy, tidal shore, mouth of Poquessing Creek, 23 Oct. 1917, *Long 18252* (PH), 9 Aug. 1923, *Long 28399* (PH); tidal marsh at the mouth of Mill Creek, Delaware River, 12 July 1972, *Ferren & Braxton 945* (PH); tidal marsh on Mud Island, Delaware River, 24 July 1972, *Ferren & Lloyd 979* (PH); tidal marsh, N side Chester Island, Delaware River, 11 Aug. 1972, *Ferren & Lloyd 1015* (PH); Tinicum Island, Delaware River, 1 July 1971, *Givens & Ferren 1575, 1578* (PH), 10 Aug. 1972, *Ferren & Lloyd 1006, 1007* (PH).

Eleocharis diandra. U.S.A. **Connecticut:** East Windsor, Connecticut River, 17 Sep. 1899, *Bissell 889* (GH), 3 Sep. 1900, *Bissell 1* (GH), 13 Sep. 1903, *Bissell s.n.* (GH); Hartford, Connecticut River, 15 Sep. 1881, *Wright s.n.* (GH), 9 Aug. 1882, *Wright s.n.* (GH), 25 Sep. 1908, *Woodward s.n.* (GH); Weathersfield, sand bars of Connecticut River, 21 Aug. 1880, *Wright s.n.* type of *E. diandra* (GH). **Massachusetts:** Northfield, sandy beach of Connecticut River, 19 Sep. 1984, *Sorrie 2772* (GH). **New York:** Verona, sandy shores, Oneida Lake, 6 Sep. 1901, *Harberer 1356* (MAINE), 27 Aug. 1968 *Hines 6846* (MICH). **Vermont:** Newbury, Connecticut River, 23 Sep. 2000, *H. Gilman 2K219* (MAINE).

KEY TO THE *ELEOCHARIS OVATA* COMPLEX OF THE EASTERN UNITED STATES

1a. Perianth bristles numbering 5–7 per achene, retrorsely barbellate, and equaling or exceeding the length of the achene and tubercle (absent in extremely rare individuals).

2a. Tubercles 0.5–0.9 mm wide, 0.65–0.97 times as wide as the achene; flowers with 2 or 3 stamens.

3a. Floral scales acute and keeled at the apex, providing a sharp-pointed aspect to the apex of the spikelet; flowers usually with 2 stamens; plants of the southeastern United States . . . . . *E. lanceolata* Fernald

3b. Floral scales rounded or obtuse at the apex, often providing a blunt aspect to the apex of the spikelet; flowers usually with 3 stamens; plants of widespread distribution.

4a. Styles usually trifid; tubercles 0.2–0.4 mm tall, 0.29–0.67 times as tall as wide; perianth bristles usually exceeding tubercle in length; spikes usually ovoid . . . . . *E. obtusa* (Willdenow) Schultes

4b. Styles bifid or sometimes trifid; tubercles 0.12–0.23 mm tall, 0.1–0.38 times as tall as wide; perianth bristles commonly not exceeding the tubercle; spikes ellipsoid to ellipsoid-cylindric . . . . . *E. engelmanii* (Steudel) House

2b. Tubercles 0.35–0.5 mm wide, 0.46–0.72 times as wide as the achene; flowers usually with two stamens . . . . . *E. ovata* (Roth) Roemer & Schultes

1b. Perianth bristles lacking or, if present, numbering 2–4, smooth, and shorter than the length of the achene.

5a. Tubercles 0.68–0.83 mm wide, 0.78–0.97 times the width of achene; anthers usually 0.48–0.71 mm long; plants occurring on lake borders and in pools and seepages . . . . . *E. engelmanii* (Steudel) House

5b. Tubercles 0.24–0.55 mm wide, 0.46–0.8 times the width of the achene; anthers 0.25–0.5 mm long; plants usually found on river shores.

6a. Floral scales purple-brown, acute and somewhat keeled at the apex; tubercle 0.1–0.2 mm tall; plants occurring on sand shores, not or only minimally tidal . . . . . *E. diandra* C. Wright

6b. Floral scales white or tinged with brown (except for the green midrib), rounded and not keeled at the apex; tubercle 0.2–0.3 mm tall; plants occurring on sand, silt, or mud shores, always tidal . . . . . *E. aestuum* D. M. Hines ex A. Haines

Acknowledgments. I thank the following people who helped with the preparation of this manuscript: Ray Angelo and Walter Kittredge (Harvard Herbaria) for specimen research and loans; Kancheepurim Ghandi (Harvard Herbaria) for assistance with taxonomy and Latin translation; Edward Voss (University of Michigan) for prompt response to numerous information requests; Galen Smith (University of Whitewater-Wisconsin) for comments and expertise in *Eleocharis*; Georgia Hall (Woodlot Alternatives, Inc.) for providing specimens for review from Merrymeeting Bay; Christopher Campbell (University of Maine) for arranging specimen loans and use of photographic equipment; Victoria Hollowell (Missouri Botanical Garden) for editorial comments and assistance with taxonomy; and David Hines (University of Michigan) for careful study during his dissertation work and for his consent to publish.

Literature Cited

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed. Von Nostrand Reinhold, New York.

Gleason, H. A. & A. C. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd ed. New York Botanical Garden, the Bronx.

Hines, D. M. 1975. A Monograph of the *Eleocharis ovata* Complex (Cyperaceae) in North America. Ph.D. Dissertation, University of Michigan.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Kartesz, J. T. 1994. A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland, 2nd ed. Timber Press, Oregon.

Schuyler, A. E. 1972. Chromosome numbers of *Scirpus purshianus* and *Scirpus smithii.* Rhodora 74: 398–406.

Sorrie, B. A. 1987. Notes on the rare flora of Massachusetts. Rhodora 89: 113–196.

Strong, M. T. 1994. Taxonomy of *Scirpus, Trichophorum,* and *Schoenoplectus* (Cyperaceae) in Virginia. Bartonia 58: 29–68.

Svenson, H. K. 1939. Monographic studies in the genus *Eleocharis.* Introduction. Rhodora 31: 121–127.

———. 1953. The *Eleocharis obtusa-ovata* complex. Rhodora 55: 1–6.

———. 1957. Cyperaceae: Scirpeae. N. Amer. Flora 18(9): 505–556.

Wright, C. W. 1883. A new *Eleocharis.* Bull. Torrey Bot. Club 10: 101.

Beaucarnea sanctomariana (Nolinaceae), a New Micro-Endemic Species of Ponytail Palm from the Isthmus of Tehuantepec, Oaxaca, Mexico

Luis Hernández-Sandoval

Escuela de Biología, Universidad Autónoma de Querétaro, Cerro de las Campanas s/n, Querétaro 76017 Qro, Mexico. luishs@sunserver.uaq.mx

ABSTRACT. A new species of ponytail palm, *Beaucarnea sanctomariana* (Nolinaceae), is described and illustrated. With this addition, the neotropical genus *Beaucarnea* now has 10 species. It occurs in tropical deciduous forests in the biodiversity hotspot area known as the Chimalapas in the Tehuantepec Isthmus, Oaxaca, Mexico. The new taxon is similar to *Beaucarnea recurvata* Lemaire and to *Beaucarnea hiriartiae* L. Hernández, but differs from both in its smaller flowers and fruits (the smallest in the entire genus), and in the articulation of the pedicel in both staminate and pistillate flowers. In addition, *B. sanctomariana* differs from *B. recurvata* in the smaller trunk bases without buttresses, shorter leaves, and undulate bracts of the inflorescence, and from *B. hiriartiae* in having widely conical trunk bases, rugose bark, smooth leaf surface, larger inflorescence stalks, and shorter inflorescence branches. A discussion of field characters is presented.

RESUMEN. Se describe e ilustra una especie nueva de "palma petacona", *Beaucarnea sanctomariana* (Nolinaceae). Con esta adición, el género Neotropical *Beaucarnea* comprende ahora 10 especies. Forma parte de los bosques tropicales caducifolios del área conocida como Las Chimalapas en el Istmo de Tehuantepec, Oaxaca, México, de gran importancia por su biodiversidad. El taxón nuevo es similar a *Beaucarnea recurvata* Lemaire y a *B. hiriartiae* L. Hernández, pero se diferencia de ellas por sus flores y frutos mucho más pequeños (los más pequeños del género) y en la articulación medial del pedicelo. Además, *B. sanctomariana* se diferencia de *B. recurvata* por las bases del tronco más pequeñas y sin contrafuertes, hojas más cortas y brácteas de la inflorescencia onduladas. De *B. hiriartiae* se distingue por las bases de los troncos anchamente cónicas, superficie lisa de sus hojas, pedúnculos de la inflorescencia más largos y ramas de la inflorescencia más cortas. Se presenta una discusión sobre caracteres de campo.

Key words: *Beaucarnea*, Mexico, Nolinaceae.

During the preparation of a taxonomic revision of the genus *Beaucarnea* (Nolinaceae), a specimen collected by Thomas L. Wendt was found to be notably different from the rest of the known species (Trelease, 1911; Hernández, 1993). The plant grows in the tropical deciduous forest in the Chimalapas region of the State of Oaxaca, Mexico, and has large recurved leaves, undulated inflorescence bracts, and the smallest flowers and fruits of the entire genus. The species is described here, and observations from the field are presented.

Beaucarnea sanctomariana L. Hernández, sp. nov. TYPE: Mexico. Oaxaca: Mpio. Santa María Chimalapa, afloramientos de roca en la cresta S del cañón del Río Corte, ca. 4 km al N de Sta. María, cerca de la vereda al Paso de la Cueva, 28 Apr. 1988, *T. Wendt 5914* (holotype, MEXU; isotypes, CHAPA, LL, MO, UAT). Figure 1.

Haec species *Beaucarneae recurvatae* similis sed ab ea bracteis inflorescentiae undulatis angustioribus atque floribus fructibusque minutis fere sessilibus differt.

Tree 4–7 m high, profusely branched; base widely conical, 1.0–1.5 m diam., 0.8–1.0 m high with thick, brown-gray bark displaying a rectangular to largely polyhedral pattern; branches elongate, slender, with leaf rosettes spherical to widely ovoid in shape. Leaves linear, recurvate, very long acuminate, 75–85 cm long, 12–16 mm wide, smooth, bright green; margins pale green, denticulate; denticles translucent white, persistent; leaf base deltate. Inflorescence a scapose thyrse, largely ovoid to largely ellipsoid in shape, 0.8–1.0 m long, 1 cm diam. at the base, peduncle branching ca. 20 cm, main axis and branches pale yellow; branches with branchlets growing sympodially; primary branches slightly undulate, the larger ones 10–15 cm long, the shorter ones 3–8 cm long; bracts of inflorescence scape and of branches linear to narrowly triangular, very long acuminate, basally undulate, pale green to yellow; secondary order branches or branchlets slightly undulate, 1–4 cm long with 10 to 20 fertile nodes, each one forming terminal cymes (rhipidia); tertiary order branches absent;

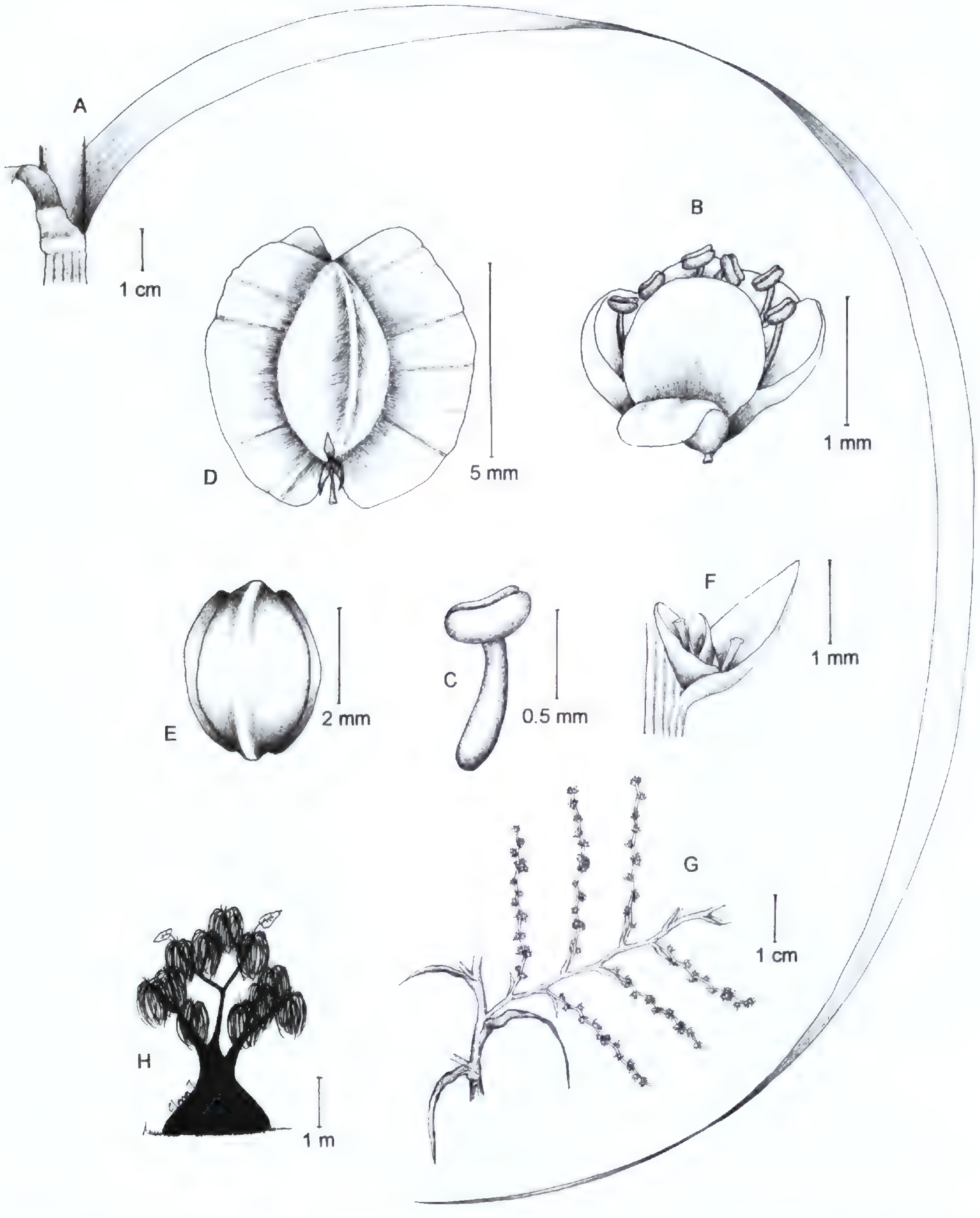


Figure 1. Illustration of *Beaucarnea sanctomariana* L. Hernández based on the herbarium specimens *Wendt 5914* and *Wendt 5915*.—A. Leaf attached to stem. —B. Staminate flower. —C. Stamen. —D. Fruit. —E. Seed. —F. Last unit of inflorescence with bracteoles and lower portions of pedicels persistent. —G. Inflorescence branch. —H. Habit shape (from a photo taken by T. Wendt).

bracts subtending secondary branches lanceolate to triangular, 4–6 mm long with 3 to 5 veins; bracts subtending flower cymes lanceolate, 2.5–3.0 mm long with one central vein; bracteoles 1–2 mm long. Staminate flowers 3 to 4(5) per node, cream yellow, fragrant; pedicels 1.5–2.3 mm long, articulated below the flower, giving the aspect of a sessile flower, lower portion of pedicels persistent; perianth segments ovate, 1.4–1.8 mm long, open but not reflexing at anthesis; anther attachment dorsifixed; ovary

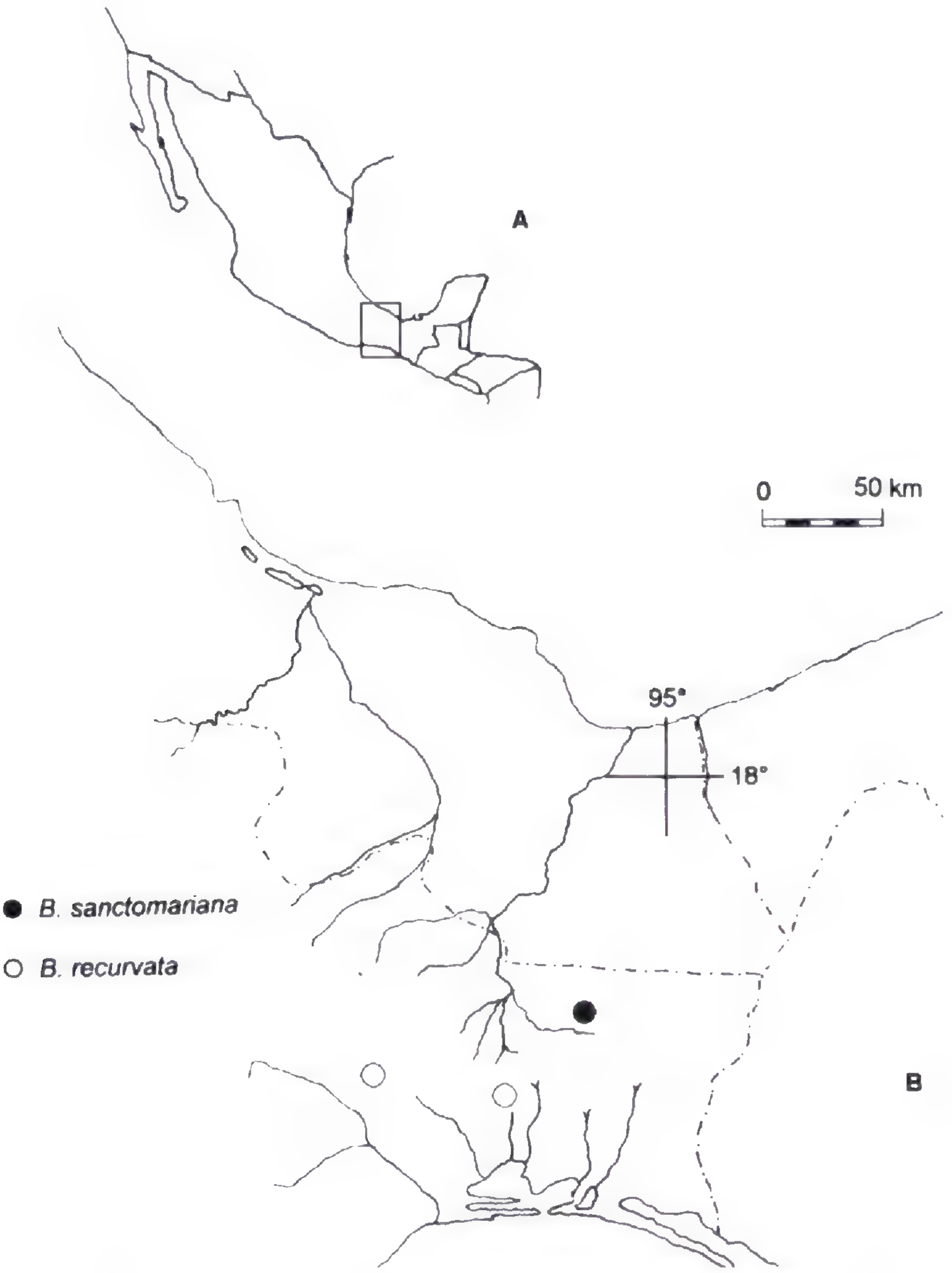


Figure 2. Distribution of *Beaucarnea sanctomariana*.—A. Mexico with the Isthmus of Tehuantepec in the square.—B. The region where the new species occurs compared with the nearest populations of *B. recurvata*.

reduced. Pistillate flowers 2 to 3(4) per node, cream yellow; pedicels 1.5–2.0 mm long, articulated at or above the middle, not giving the aspect of a sessile flower, lower portion of pedicels persistent; perianth segments ovate, 1.0–1.5 mm long; ovary ellipsoid, basally winged, slightly auriculate, with basal septal nectaries; style ca. 0.5 mm, stigmatic lobes round to ovate, papillate. Fruit pedicels enlarged when maturing, 2.0–2.5 mm long, articulated near the middle (ca. 1 mm). Fruits ellipsoid to almost spherical, 6–8 mm long, 5–7 mm wide, pale green tinged with red at the wings when immature, turning pale yellow when maturing, with an apical notch 0.5–1.0 mm long and wide; perianth segments persistent, the internal adpressed, and the external reflexed, hiding the pedicel; style persistent, enlarged to 1.5 mm long; stigmatic branches persistent, dark brown. Seeds (only immature seen) with apices of lobes very irregular; testa rugose, red-brown.

Distribution and habitat. *Beaucarnea sanctomariana* is restricted to karstic rocky outcrops with xerophytic vegetation. The outcrops emerge from the surrounding tropical deciduous forest. The plants are rare, and occur between 200 and 250 m altitude on steep slopes of the Corte river at the type locality at Santa María Chimalapa, Oaxaca, Mexico (Fig. 2). This area is considered a biodiversity hotspot, since it is a small area with high plant diversity and a high degree of endemism (Wendt, 1993). The populations of *B. recurvata* that are geographically closest to *B. sanctomariana* are restricted to the Pacific slopes of the Isthmus of Tehuantepec, whereas the new species is found only on the side facing the Gulf of Mexico. However, due to similar ecological conditions, it is probable that more populations of the new species occur along other tributaries of the Coatzacoalcos river. Due to the ecological status of the species of *Beaucarnea* (Hernández, 1993a; Nom-059-Ecol., 1994),

Table 1. Data comparing the new species *Beaucarnea sanctomariana* with *B. recurvata* and *B. hiriartiae*.

	B. sanctomariana	*B. recurvata*	*B. hiriartiae*
Distribution in Mexico	Oaxaca (facing the Gulf of Mexico)	Veracruz, Oaxaca	Guerrero
Mature trunk base diameter (m)	1.0–1.5	2.0–3.0	0.8–1.0
Mature leaf length (cm)	75–85	100–115	70–90
Mature leaf width (mm)	12–16	13–20	10–15
Leaf surface	smooth	smooth	papillate
Inflorescence stalk (cm)	ca. 20	20–30	10–15
Inflorescence lower primary branches (cm)	10–15	(15)20–30	25–30
Inflorescence bracts	sometimes undulate	straight	undulate to coiled
Perianth segments (staminate flowers; mm)	1.4–1.8	2.0–2.5	3.0–3.6
Perianth segments (pistillate flowers; mm)	1.0–1.5	2.5–4.0	2.0–2.5
Fruit shape (at immature stages)	widely ellipsoid to spherical	ellipsoid	ellipsoid
Fruit size: length × width (mm) at immature stages	6–8 × 5–7	10–12 × 7–8	8–10 × 5–8
Pedicel articulation of the staminate flower	Very close to the flower	Above the middle	Above the middle

and the distribution of the new taxon, it can be considered as a micro-endemic endangered species. However, population studies are needed. Specimens with flowers and immature fruits have been collected in April.

Etymology. The name of the species refers to the region where it lives, Santa María Chimalapa.

Beaucarnea sanctomariana is morphologically similar to *B. hiriartiae* and *B. recurvata*. With *B. hiriartiae* it shares the recurved leaves, the undulate bracts, and general color of the inflorescence. With *B. recurvata* it shares the shape of the trunk base, and the recurved, smooth leaves. Attributes that characterize *B. sanctomariana* are the short inflorescence branches (primary branches 10–15 cm long, highest order branches 1–4 cm long), the small flowers (1–2 mm long), fruit size (6–8 mm long, 5–7 mm wide), spherical immature fruits (vs. ellipsoid immature fruits in the other species), and the pedicels articulated at the middle. *Beaucarnea sanctomariana* notably differs from *B. hiriartiae* in the widely conical trunk bases, rugose bark, smooth leaves, large inflorescence stalk, and shorter inflorescence branches (Hernández, 1992). This new species is distinguished from *B. recurvata* by the smaller trunk bases without buttresses, shorter leaves, slightly undulate bracts subtending the inflorescence branches, and the rounded fruits (Lemaire, 1861; Hernández, 1993). Table 1 summarizes other important diagnostic differences between these taxa. It must be stressed that when herbarium specimens of closely related species are examined, it is not easy to detect critical characters. Field characters like tree architecture, bark, and persistence of old leaves on the trunk, are diagnostic characters that are underestimated by most collectors. For example, *B. sanctomariana* and *B. recurvata* have the typical Leeuwenberg model of tree architecture (Hallé et al., 1978) (Fig. 1). However, *B. hiriartiae* presents a variation in that when branching, the meristems of only one branch seem to take the apical dominance, leaving the remaining branches with reduced rates of growth. As a result, the habit of *B. hiriartiae* resembles a tree with its branches growing only to one side, enough to distinguish it in the field from *B. sanctomariana* and *B. recurvata*.

Paratypes. MEXICO. **Oaxaca:** Santa María Chimalapa, roca al S del Río Corte, 30 Apr. 1986, *Hernández 2198* (CHAPA); Mpio. Santa María Chimalapa, afloramientos de roca en la cresta S del cañón del Río Corte, ca. 4 km al N de Sta. María, cerca de la vereda al Paso de la Cueva, 28 Apr. 1988, *Wendt 5915* (TEX, UAT).

Acknowledgments. I thank Thomas L. Wendt for bringing to my attention the specimens upon which the new species is based. Guy Nesom provided the Latin description. Clara Tinoco made the illustration. Mahinda Martínez and Maricela Gómez kindly reviewed the manuscript. Robert Jones corrected the English version of the paper.

Literature Cited

Hallé, F., R. Oldeman & P. Tomlinson. 1978. Tropical Trees and Forests: An Architectural Analysis. Springer-Verlag, Berlin.

Hernández, L. 1992. Una especie nueva de *Beaucarnea* (Nolinaceae). Acta Bot. Mexicana 18: 25–29.

———. 1993. Cladistic Analysis of the American Genera of Asparagales and the Systematic Study of *Beaucarnea* (Nolinaceae) and *Hemiphylacus* (Hyacinthaceae). Ph.D.

Dissertation, The University of Texas at Austin, Austin, Texas.

———. 1993a. *Beaucarnea* ¿un género amenazado? Cactáceas y Suculentas de México 38: 11–14.

Lemaire, Ch. 1861. Genre nouveau de la Famille de Asparagaceés. *Beaucarnea.* L'Illustration Horticole 8: 57–62.

Nom-059-Ecol. 1994. Lista de especies amenazadas y en peligro de extinción. Diario Oficial de la Federación. Gobierno Constitucional de los Estados Unidos Mexicanos. P. 7.

Trelease, W. 1911. The desert group Nolineae. Proc. Amer. Philos. Soc. 50: 404–443.

Wendt, T. 1993. Composition, floristic affinities, and origins of the canopy tree flora of the Mexican Atlantic slope rain forests. Pp. 577–680 *in* T. P. Ramamoorthy, R. Bye, A. Lot & J. Fa (editors), Biological Diversity of Mexico: Origins and Distribution. Oxford Univ. Press, New York–Oxford.

Buckiella, a New Genus in the Hypnaceae (Musci)

Robert R. Ireland
Smithsonian Institution, Department of Botany, National Museum of Natural History, Washington, D.C. 20560-0166, U.S.A.

ABSTRACT. A new genus, *Buckiella*, is segregated from *Plagiothecium*. The type species, *Buckiella undulata* (Hedwig) Ireland, known from western North America, Europe, China, and New Guinea, has plants with strongly undulate leaves, short, inconspicuous triangular leaf decurrencies, minute, granular, cuticular papillae covering the leaf cells, and wrinkled capsules. A second species, *B. draytonii* (Sullivant) Ireland, endemic to the Hawaiian Islands, with undulate, nondecurrent leaves, cuticular papillae on the leaf cells, and wrinkled capsules is also included in the genus.

Key words: *Buckiella*, China, Europe, Hawaiian Islands, Hypnaceae, Musci, New Guinea, North America, *Plagiothecium*.

Plagiothecium undulatum (Hedwig) Schimper has always been one of the most distinct and easily recognized species in the genus *Plagiothecium* in North America and Europe. The two primary reasons for originally placing the species in the genus were its complanate-foliate plants and decurrent leaves. However, the species has several distinctive characters that consistently distinguish it from the other species in *Plagiothecium* and warrant establishing it as a new genus in the Hypnaceae.

Buckiella Ireland, gen. nov. TYPE: *Buckiella undulata* (Hedwig) Ireland.

Plantae dioicae hebetatae vel aliquantum nitidae pallide virides vel albo-virides interdum flavo-virides; caulis et ramis prostratis complanato-foliatis interdum julaceis magnis ad 15 cm longis vel ultra 1–7 mm latis; foliis imbricatis valde undulatis concavis ovatis vel ovato-lanceolatis acutis vel acuminatis non decurrentibus cellulis breviter decurrentibus 1–3; costis brevibus duplicibus; parietibus cellularum papillis cuticularibus minute granulatis obtectis; gemmis nullis. Setae elongatae ad 4.5 cm longae; capsulae inclinatae vel pendulae; thecis rugulosis; peristomis perfectis hypnaceis; opercula rostrata.

Buckiella undulata (Hedwig) Ireland, comb. nov.
Basionym: *Hypnum undulatum* Hedwig, Sp. Musc. Frond. 242. 1801. *Plagiothecium undulatum* (Hedwig) Schimper, in Bruch, Schimper & W. Gümbel, Bryol. Eur. 5: 195. 1851 (fasc. 48 Mon. 17. 13). *Stereodon undulatus* (Hedwig) Mitten, J. Linn. Soc., Bot. 8: 39. 1865. *Neckeropsis undulata* (Hedwig) Kindberg ex J. A. Allen, Mosses Cascade Mount. 117. 1900. [(Later homonym) (non (Hedwig) Reichardt 1870)]. TYPE: In silvis densis acerosis ad terram, in cavernosis saxosis Europae, in Hercynia Franconia (holotype?, G specimen in Hedwig-Schwaegrichen herbarium with no information on packet).

Plagiothecium undulatum subsp. *subneckeroideum* Kindberg, Rev. Bryol. 36: 42. 1909. TYPE: Canada. British Columbia: Vancouver Island, Departure Bay, Newcastle Island, 10 July 1908, *J. Macoun* (isotype?, CANM).

Plagiothecium undulatum var. *myurum* Cardot & Thériot, Univ. Calif. Publ. Bot. 2: 304. 1906. *Plagiothecium undulatum* fo. *myurum* (Cardot & Thériot) Jedlička, Spisy Přír. Fak Masarykovy Univ. ser. L2 no. 308: 14. 1948. *Plagiothecium myurum* (Cardot & Thériot) Jedlička, Spisy Přír. Fak Masarykovy Univ., ser. L4, no. 318: 4. 1950. TYPE: Unalaska, June–Aug. 1899, *W. A. Setchell s.n.*, (holotype, PC).

Plants dull or somewhat glossy, light green or whitish green, sometimes yellowish green, in thin to loose mats, stems to 15 cm long or longer, 1–7 mm wide. Stems and branches prostrate and complanate-foliate or sometimes erect and julaceous (ecological variation described as var. *myurum*, which I consider a synonym). Leaves imbricate, not spreading, strongly undulate, especially near apices, somewhat contorted near stem and branch apices, concave, usually symmetric, 2–5 mm long, 1–2 mm wide, ovate to ovate-lanceolate, rarely oblong-lanceolate, acute to acuminate, rarely somewhat obtuse; rhizoids brown to reddish brown, smooth or rarely minutely papillose, on the leaves on the undersurface of the stems from the base of the stems and branches about halfway up, borne on the costae and adjacent cells on the abaxial surface; margins plane, entire or usually serrulate to serrate at apices; costae short and double, ending

a short distance above base, rarely one branch reaching ⅓ length of leaf; leaf cells covered with minute, granular, cuticular papillae, the papillae much more abundant on the abaxial surface than on the adaxial surface, walls of basal cells pitted; median cells mostly 96–175 μm long, 7–11 μm wide; decurrent alar regions triangular in outline, often indistinct, consisting of 1–3 rectangular cells extending down stem, 40–132 μm long, 9–22 μm wide, terminating at the base in a single cell. Asexual reproductive bodies unknown.

Dioicous, often fruiting. Seta 2.5–4.5 cm long, often curved, rarely circinate, dark red to light brown. Capsule inclined to pendulous, arcuate, or sometimes straight, light brown to orange-brown when mature. Urn 1.5–4.0 mm long, 0.4–0.9 mm wide, wrinkled, contracted below mouth when dry. Operculum rostrate, 0.8–1.2 mm long. Annulus deciduous. Peristome perfect, hypnaceous; exostome papillose in upper half, with fine transverse striations between the lamellae in lower half; endostome with 2–3 cilia, as long as or nearly as long as segments. Spores globose to ovoid, smooth or minutely papillose, 11–14 μm in greatest dimension. Calyptra cucullate, white to yellow, fugacious. Chromosome number: $n = 11$ (Smith & Newton, 1968).

Habitat. At low elevations in coniferous forests, often on rotten logs, stumps, and bases of trees; sometimes on boggy soil or soil and humus overlying rock; 0–1310 m; British Columbia; southern Alaska, extending out the Aleutian Islands to Attu Island, northern California and Idaho, Oregon, and Washington; northern, western, and central Europe, Faroes, Siberia (Smith, 1978); China: Anhui, Guizhou, Hubei, Heilongjiang, Jilin, Liaoning, Shandong, and Xizang Provinces (Redfearn et al., 1996); and New Guinea.

Illustrations. Ireland (1969), Lewinsky (1974), Smith (1978).

The genus *Plagiothecium* was last revised for North America by Ireland (1969), who fully illustrated and described the species and who later did a synopsis of the genus for the continent (Ireland, 1986). A scanning electron microscope study was also done on the spores of the North American species (Ireland, 1987). Jedlička (1948, 1950) monographed and illustrated the European species, including *B. undulata.* Iwatsuki (1970) revised the genus for Japan and adjacent areas but did not report *B. undulata* from that region. It has been reported from several provinces in China (Redfearn et al., 1996), and recently I have confirmed its presence in Yunnan Province (*Redfearn, He & Su 826,* MO). Ireland (1986) reported a recent discovery of *B. undulata* from a single locality in New Guinea (Mount Wilhelm, *Wade 233* (MICH), forwarded by Howard Crum, University of Michigan).

Buckiella undulata has been included in *Plagiothecium* by both Ireland and Jedlička, as well as by other bryologists, primarily on the basis of its complanate habit and decurrent leaf cells. However, it is now evident the species can be placed in the Hypnaceae as a separate genus since other species in some genera of the Hypnaceae have complanate plants with shortly decurrent leaves with 1–3 cells similar to those of *Buckiella undulata,* e.g., *Hypnum.* Indeed, Mitten (1865) at one time placed *Buckiella undulata* (as *Plagiothecium undulatum*) in the genus *Stereodon* nom. illeg., an illegitimate generic name for *Hypnum* nom. cons.

I (Ireland, 1969) commented when I first revised the genus *Plagiothecium* that the family Plagiotheciaceae is merely a weak segregate of the complex family Hypnaceae. Later, however, I agreed with W. R. Buck (Buck & Ireland, 1985) that it is a distinct family containing only *Plagiothecium* when we reclassified the Plagiotheciaceae, and a year later (1986) I confirmed the fact that it is prudent to recognize it as a monotypic family. Most of the 44 *Plagiothecium* taxa listed by Crosby et al. (1999) share a number of features that help establish the family, but until a worldwide monograph is done on *Plagiothecium* I still consider the Plagiotheciaceae to be a weak segregate of the large family Hypnaceae.

Members of *Plagiothecium* are mostly complanate-foliate with simple or scarcely branched stems that have an outer row of thin-walled cells; smooth or papillose rhizoids that arise from the stem cells just below the leaf insertion, often from cells on or beside the abaxial surface of the costae at the base of the leaves, or sometimes from cells on the abaxial surfaces of the leaf apices (Crundwell (1979) noted that they also occur here in one other pleurocarpous family, the Amblystegiaceae); leaves that are often asymmetric and generally always strongly decurrent with several rows of cells that are easily seen when the leaves are stripped off one side of the stem; costae short and double; leaf cells that are always smooth, more or less linear, densely chlorophyllose; alar cells that are differentiated, confined to the basal angles, cylindric or fusiform; septate brood-bodies of 2–7 cells, arising from branched stalks often present on stems; and capsules with hypnoid peristomes.

The family Hypnaceae, in comparison, has plants occasionally complanate-foliate but more often spreading and usually pinnately branched stems that have an outer row of thick- or thin-

walled cells; smooth or papillose rhizoids that are borne on the stems in the leaf axils or below the leaf attachment (Crundwell (1979) noted that *Taxiphyllum* has rhizoids nearest *Plagiothecium* since they are borne at the stem-leaf junction and vary from smooth to papillose) but apparently not at the leaf apices; leaves that are usually symmetric and seldom strongly decurrent with several obvious rows of cells; costae short and double, leaf cells that are smooth, sometimes papillose, but also with projecting cell ends (prorate), often linear, usually densely chlorophyllose; alar cells that are often differentiated, confined to the basal angles; various types of gemmae but occasionally with cylindrical or fusiform brood-bodies (e.g., *Isopterygiopsis*) like the Plagiotheciaceae but arising from stems on unbranched stalks; and capsules that have hypnoid peristomes.

Although I still believe that not enough is known about many of the hypnaceous genera to safely segregate out anything but a narrow monogeneric family Plagiotheciaceae, Hedenäs (1987, 1989, 1995) has continued to recognize a broader concept of the family. In addition to *Plagiothecium,* in which he placed *Buckiella undulata,* he included several other genera and species in the family that are placed in the Hypnaceae by many present-day bryologists, including *Catagonium, Isopterygiopsis,* and *Pseudotaxiphyllum elegans* (Bridel) Iwatsuki. Hedenäs (1987) separated the Plagiotheciaceae from the Hypnaceae by seven characters that he considered important enough to distinguish the two families, namely rhizoid position, rhizoid color, rhizoid ornamentation, branches, perichaetial leaves, exostome color, and exostome border. However, I believe many of the characters that he used for family distinction are insignificant, difficult to interpret and, due to insufficient studies, relatively meaningless, especially since he stated that his studies on the pleurocarpous mosses (Hedenäs, 1989: 157) are "somewhat biased since they included many more species of the holarctic region than of other biogeographic regions." He omitted many of the tropical and Southern Hemisphere species in his assessment of the families, which is a serious omission because of the large number of species in those regions.

Hedenäs used branches easily detached in the Plagiotheciaceae versus firmly attached in the Hypnaceae, which is not always a very distinctive character and one which is often difficult to determine. Although some of the branches in *Plagiothecium,* including those of *Buckiella,* do seem to be easily detached, other branches, especially the smaller ones, do not. The branches possess some rhizoids at their base, and the easy detachment apparently represents a means of asexual reproduction that has not been reported in the past.

The rhizoid character that Hedenäs used seems to be the best. However, there are some problems. He stated that *Isopterygium elegans* (= *Pseudotaxiphyllum elegans* (Bridel) Z. Iwatsuki) is clearly separate from the other North European species in having the rhizoids inserted below the leaves. From the specimens I examined in Europe and North America, the rhizoids are borne at the base of the leaves on their abaxial surfaces. The rhizoid color he used is ambiguous, since in the Plagiotheciaceae he stated the rhizoids are purple (especially noticeable in the young rhizoids, according to him) or rarely dark red-brown, while in the Hypnaceae they are brown or reddish brown. I did not observe any of the rhizoids to be purple in any *Plagiothecium* species or in *Pseudotaxiphyllum elegans* (Bridel) Z. Iwatsuki. All of the rhizoids, including those of *Buckiella,* appear to be brown or reddish brown. The rhizoids in the Plagiotheciaceae according to Hedenäs are usually granular-papillose (rarely smooth), and in the Hypnaceae they are smooth. In *Pseudotaxiphyllum elegans,* which he placed in the Plagiotheciaceae, he pointed out that the young rhizoids are rough and the older ones smooth or less rough. Inconsistencies or ambiguities such as these make family distinction very difficult, and I seriously doubt if now is the time to split off families like the Plagiotheciaceae containing any genera besides *Plagiothecium* until more is known about all species in the Hypnaceae.

One major microscopic character of the species that helps to establish the genus *Buckiella* and one that I consider very important was found during my 1969 revision of *Plagiothecium.* Minute, granular cuticular papillae were discovered covering all the leaf cells in all the specimens I studied. The papillae are much more common on the abaxial surfaces of the leaves (Fig. 1A, B) than on the adaxial surfaces (Fig. 2A). This is the only species of *Plagiothecium* in North America that was observed with any papillae on their leaves. They are discernable under the compound microscope at magnifications of ×400 or more (see Ireland, 1969, fig. 7, illustration of portion of cells of *Plagiothecium undulatum*). The cuticular papillae can be seen much more clearly under a scanning electron microscope (SEM) as shown in Figures 1 and 2. These irregularly shaped cuticular papillae were first shown under the SEM by Lewinsky (1974). Similar papillae have not been seen in any species in genera of the Hypnaceae, although many of them in the family have not yet been investigated. The

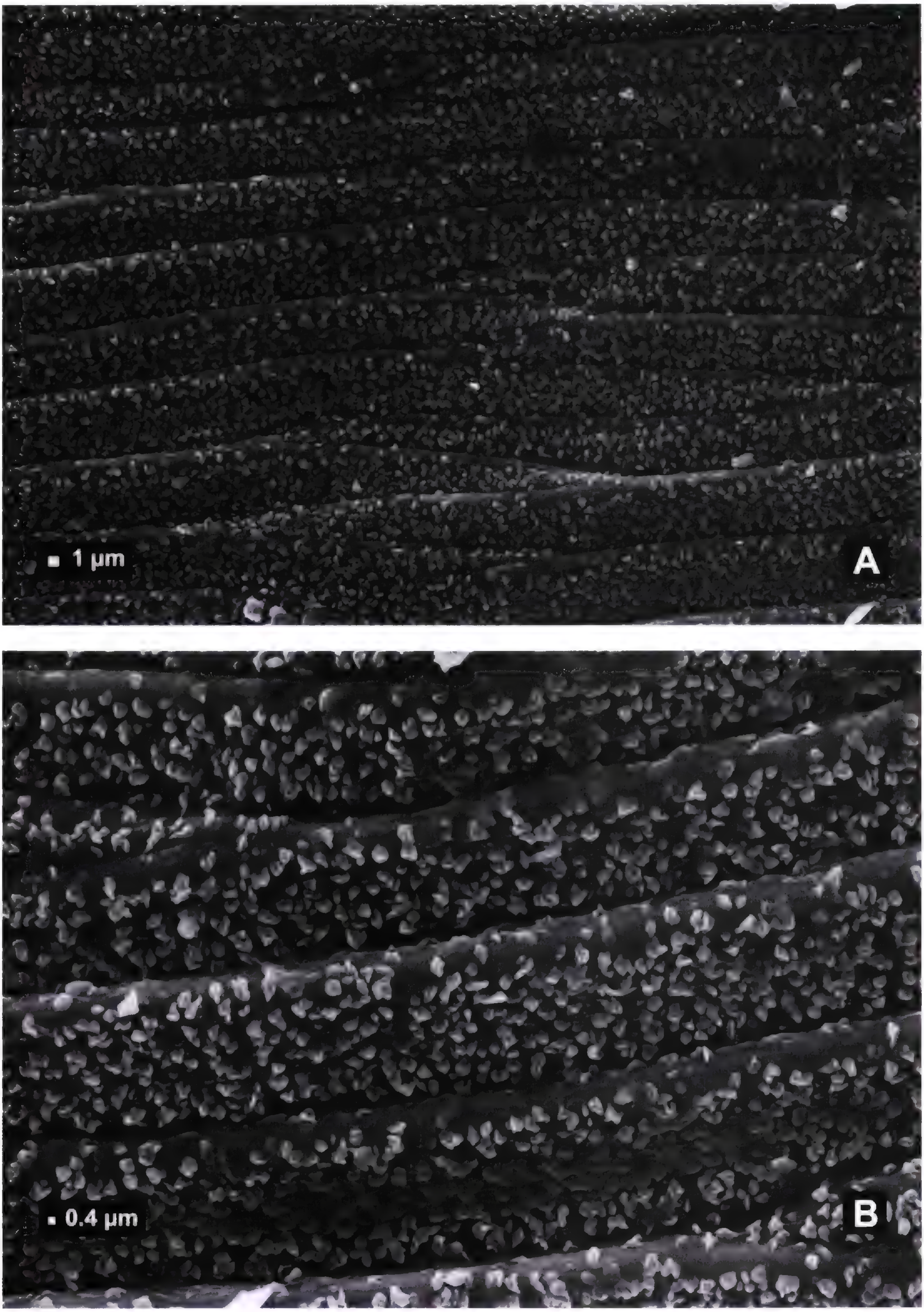


Figure 1. Scanning electron (SEM) photomicrographs of leaf cells of *Buckiella undulata*.—A, B. Cuticular papillae on abaxial surface of leaf from Washington specimen (*Ireland 5513*, US).

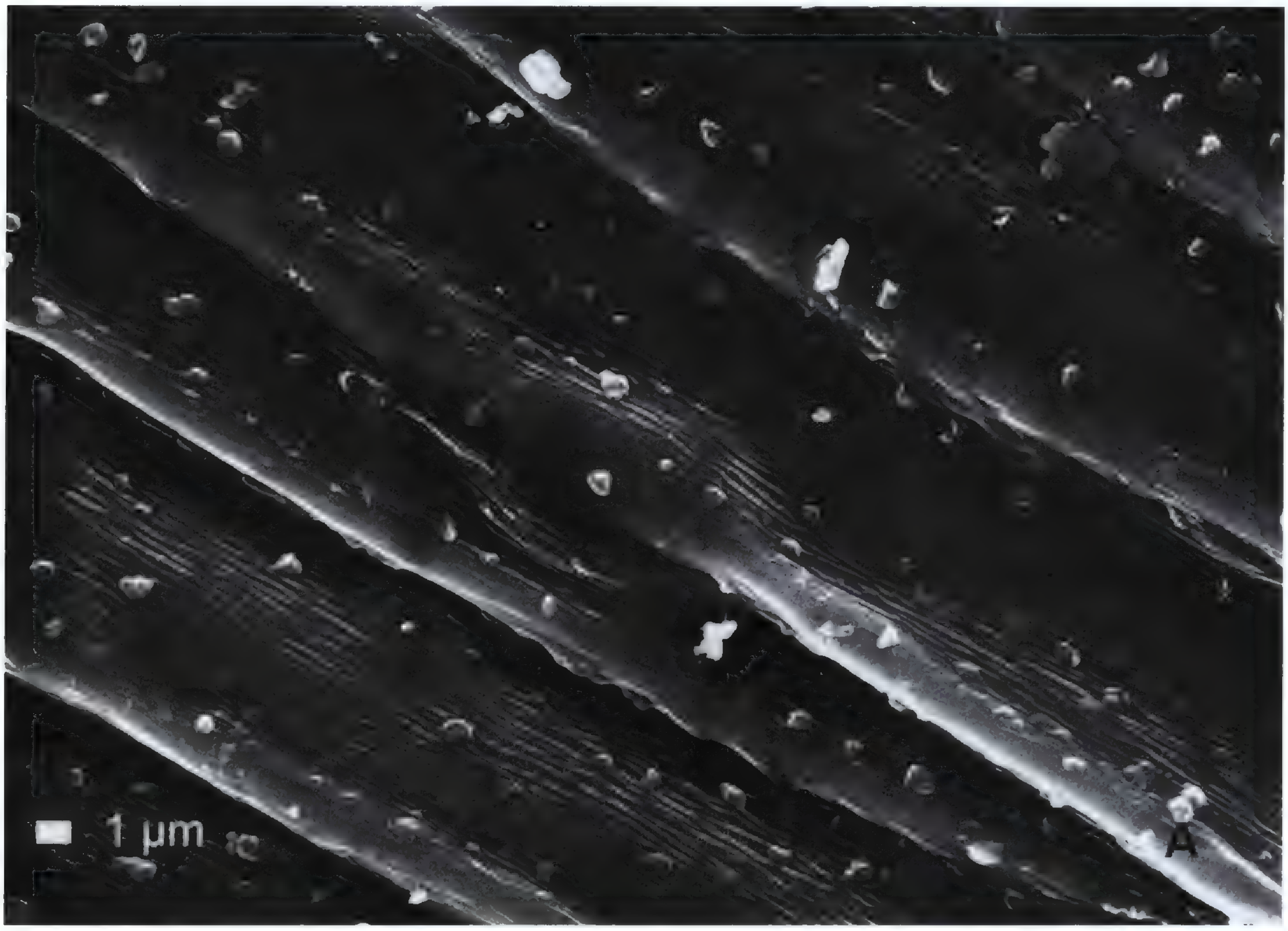


Figure 2. Scanning electron (SEM) photomicrographs of leaf cells of *Buckiella*.—A. Cuticular papillae on adaxial surface of leaf of *B. undulata* from Washington specimen (*Ireland 5513*, US). —B. Cuticular papillae on abaxial surface of leaf of *B. draytonii* from Hawaiian specimen (*Hoe*, Bryophyta Hawaiica Exsiccata *45*, US).

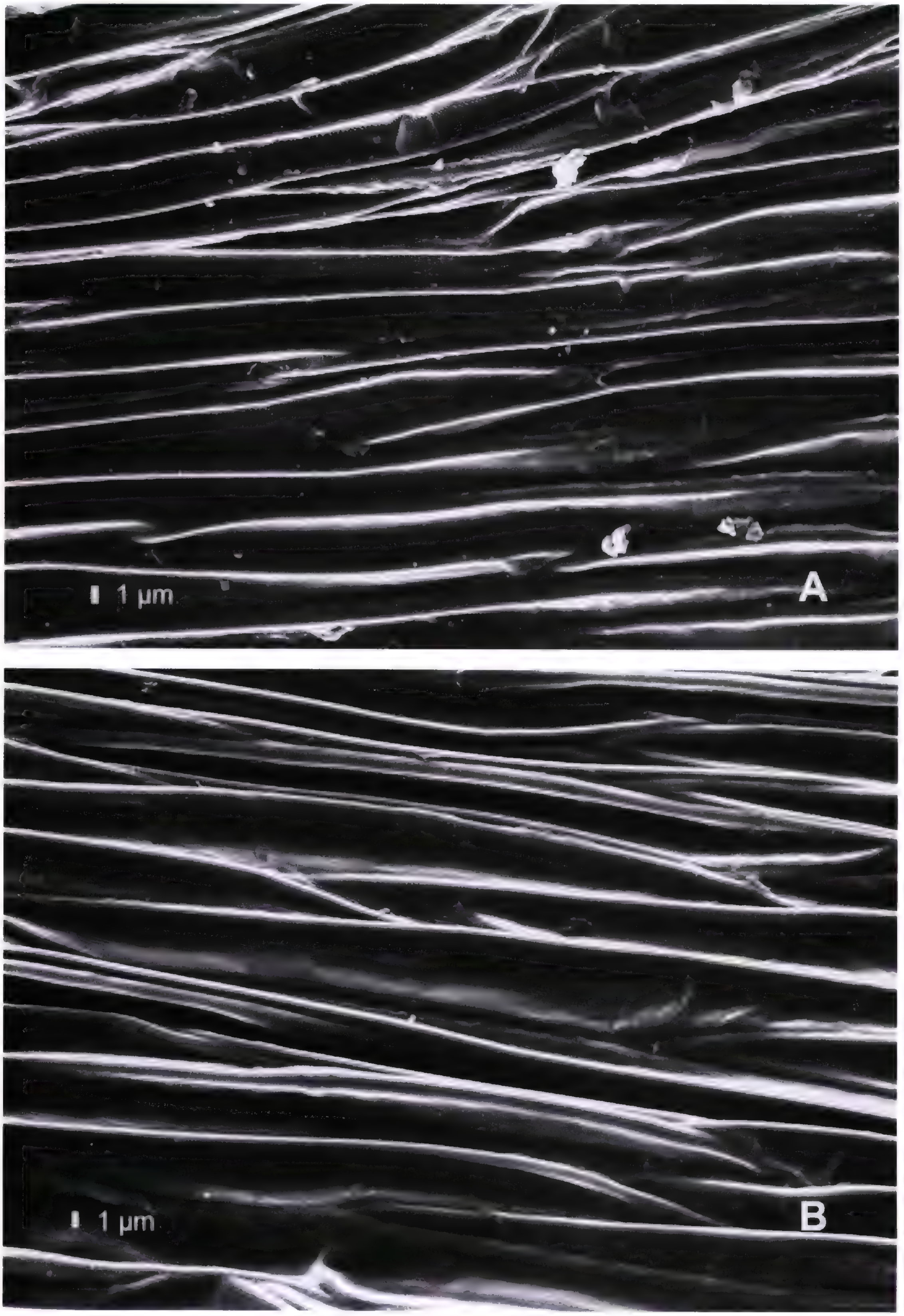


Figure 3. Scanning electron (SEM) photomicrograph of leaf cells of *Plagiothecium denticulatum*.—A. Abaxial surface of leaf cells from Alberta specimen (*Ireland 9564*, US). —B. Adaxial surface of leaf cells from Alberta specimen (*Ireland 9564*, US).

smooth leaf cells of *Plagiothecium denticulatum* (Hedwig) Schimper are shown under the SEM (Fig. 3A, B), and similarly smooth cells are shown by Lewinsky (1974) of *P. laetum* Schimper.

Features that are important for placing *B. undulata* in the Hypnaceae are the symmetric leaves with very short, inconspicuous leaf decurrencies of only 1–3 cells, similar to species in some genera of the family. This is in contrast to species of *Plagiothecium*, which usually have asymmetric leaves with long, conspicuous leaf decurrencies in several rows extending down the stems. Also, there are minor features of *B. undulata* that are similiar to the Hypnaceae in regard to its leaves that never have rhizoids at the leaf apices like most species of *Plagiothecium*, and no cylindrical or fusiform asexual reproductive bodies are ever produced like those in several species of *Plagiothecium*.

Plagiothecium draytonii (Sullivant) E. B. Bartram, an endemic species of the Hawaiian Islands, also has granular cuticular papillae (Fig. 2B), as well as other morphological features of the new genus *Buckiella*, e.g., undulate, nondecurrent leaves and wrinkled capsules. Therefore, I am including it in the genus.

Buckiella draytonii (Sullivant) Ireland, comb. nov. Basionym: *Hypnum draytoni*(*i*) Sullivant, Proc. Amer. Acad. Arts Sci. 3: 76. 1854. *Plagiothecium draytoni*(*i*) (Sullivant) E. B. Bartram, Bishop Mus. Bull. 101: 223. 1933. *Catagonium draytoni*(*i*) (Sullivant) Müller Halle, Flora 82: 468. 1896. TYPE: Hawaiian Islands [U.S.A.]. Hawaii: Mauna Kea, *C. Wilkes Expedition* (holotype, FH not seen).

Hypnum eudorae Sullivant, Proc. Amer. Acad. Arts Sci. 3: 77. 1854. TYPE: Hawaiian Islands [U.S.A.]. Oahu: Kaala Mountains, *C. Wilkes Expedition* (holotype, FH not seen).

A complete description, habitat information, and distribution information of *B. draytonii* are found in Bartram (1933). *Buckiella draytonii* differs from *B. undulata* by the smaller plants, 5–10 cm long, by the smaller leaves, ca. 1 mm wide and 2 mm long, with a longer acuminate apex that is smooth or has only a few serrulations, and by the complete lack of decurrent cells. In comparison *B. undulata* has larger plants, sometimes over 15 cm long, larger leaves, 1–2 mm wide and 2–5 mm long, mostly acute or at times obtuse, less often acuminate at the apex with several serrations, and 1–3 decurrent cells, although they are often indistinct. The rhizoids are the same in both species. Also, both species are dioicous and possess wrinkled capsules.

Buckiella seems to be an isolated genus in the Hypnaceae, and to my knowledge it is not close to any extant genus. It is just as distinctive a genus in the Hypnaceae as it was in its former family the Plagiotheciaceae.

A. J. Sharp, University of Tennessee, suggested over 30 years ago, when I first started studying the genus, that perhaps a new genus should be described to accommodate *Plagiothecium undulatum*. He based his opinion on the superficial appearance of the species compared to the other species in the genus. It was the later discovery of the leaf cell papillae in my revision of the North American species of *Plagiothecium* that strongly convinced me after all these years to segregate the species into a new genus in a different family. In my synopsis of the genus (1986), I then mentioned that there are enough distinctive features to describe a new genus to accommodate the taxon. It is truly a pleasure to name this new genus in honor of William R. Buck, New York Botanical Garden, a long-time friend and authority of the pleurocarpous mosses who recently published his outstanding book, *Pleurocarpous Mosses of the West Indies* (Buck, 1998).

Acknowledgments. I thank Harold Robinson, Smithsonian Institution, for his comments on this paper and especially for writing the Latin diagnosis. I am especially grateful to Susann Braden and Marjorie Knowles, Smithsonian Institution, for preparing the moss material for study under the scanning electron microscope and taking the photographs, which were done in the National Museum of Natural History SEM Laboratory using a Leica Stereoscan 400. Ms. Knowles further assisted in preparing the plates and manuscript for publication, for which I am very appreciative. Finally, I thank Marshall Crosby, Missouri Botanical Garden, and Lars Hedenäs, Swedish Museum of Natural History, for helpful comments.

Literature Cited

Bartram, E. B. 1933. Manual of Hawaiian Mosses. Bishop Mus. Bull. 101. Pp. 222–226.

Buck, W. R. 1998. Pleurocarpous Mosses of the West Indies. Mem. New York Bot. Gard. 82: 1–400.

——— & R. R. Ireland. 1985. A reclassification of the Plagiotheciaceae. Nova Hedwigia 41: 89–125.

Crosby, M. R., R. E. Magill, B. Allen & S. He. 2000. A Checklist of the Mosses. Missouri Botanical Garden, St. Louis. [Published by the Authors.]

Crundwell, A. C. 1979. Rhizoids and moss taxonomy. Pp. 347–363 *in* G. C. S. Clark & J. G. Duckett (editors), Bryophyte Systematics. Academic Press, London.

Hedenäs, L. 1987. North European mosses with axillary rhizoids, a taxonomic study. J. Bryol. 14: 429–439.

———. 1989. Some neglected character distribution pat-

terns among the Pleurocarpous mosses. The Bryologist 92: 157–163.
———. 1995. Higher taxonomic level relationships among diplolepidous pleurocarpous mosses—A cladistic overview. J. Bryol. 18: 723–781.
Ireland, R. R. 1969. A Taxonomic Revision of the Genus *Plagiothecium* for North America, North of Mexico. National Museums of Canada, National Museum of Natural Sciences, Publ. Bot. No. 1: 1–118.
———. 1986. Synopsis of the genus *Plagiothecium* for North America. Lindbergia 12: 49–56.
———. 1987. Scanning electron microscope study of the spores of the North American species of *Plagiothecium*. Mem. New York Bot. Gard. 45: 95–110.
Iwatsuki, Z. 1970. A revision of *Plagiothecium* and its related genera from Japan and her adjacent areas, I. J. Hattori Bot. Lab. 33: 331–380.
Jedlička, J. 1948. Monographia specierum europaerum gen. *Plagiothecium* s.s. (Partis specialis I. Summarium). Spisy Přír. Fak. Masarykovy Univ., ser. L2, no. 308: 1–45.
———. 1950. Monographia specierum europaerum gen. *Plagiothecium* s.s. Icones. Spisy Přír. Fak. Masarykovy Univ., ser. L4, no. 318.
Lewinsky, J. 1974. The family Plagiotheciaceae in Denmark. Lindbergia 2: 185–217.
Mitten, W. 1865. The "Bryologia" of the survey of the 49th parallel of latitude. J. Linn. Soc. Bot. 8: 12–55.
Redfearn, P. L., Jr., B. Tan & S. He. 1996. A newly updated and annotated checklist of Chinese mosses. J. Hattori Bot. Lab. 79: 163–357.
Smith, A. J. E. 1978. The Moss Flora of Britain and Ireland. Cambridge Univ. Press, Cambridge.
——— & M. E. Newton. 1968. Chromosome studies on some British and Irish mosses III. Trans. Brit. Bryol. Soc. 5: 463–522.

Hydrocharitaceae from Central Brazil: A New Species of *Egeria* and a Note on *Apalanthe granatensis*

Samantha Koehler
Departamento de Botânica, I.B., UNICAMP, Caixa Postal 6109, 13083-970 Campinas, SP, Brazil. skoehler@unicamp.br

Claudia Petean Bove
Departamento de Ciências Naturais, E.C.B., UNI-RIO, Frei Caneca 94 5° andar, 20221-040, Rio de Janeiro, RJ, Brazil. cpbove@ibpinet.com.br

ABSTRACT. *Egeria heterostemon* (Hydrocharitaceae), a new species from central Brazil, is described and illustrated. It is distinguished from congeneric species by its flowers having heteromorphic whorls of stamens, and by its long-stalked clavate staminodes, which are strongly papillose distally. Further, taxonomic notes on *Apalanthe granatensis* (Humboldt & Bonpland) Planchon are presented, and a key to species of both genera is provided.

Key words: *Apalanthe*, Brazil, *Egeria*, Hydrocharitaceae.

The family Hydrocharitaceae consists of 17 genera, 9 of which are found in South America (Cook, 1996). Of these, *Apalanthe* Planchon and *Egeria* Planchon are considered here. Molecular phylogenetic analysis of the Hydrocharitaceae strongly supports the genera *Apalanthe*, *Egeria*, and *Elodea* Michaux as a monophyletic group, with *Egeria* + *Elodea* as the sister group of *Apalanthe* (Les et al., 1997). As a result of fieldwork for the *Aquatic Flora of the Araguaia River Region Project*, a third species of *Egeria* from the states of Mato Grosso and Goiás, in central Brazil, is described below. New taxonomic data for *Apalanthe granatensis* (Humboldt & Bonpland) Planchon are also presented.

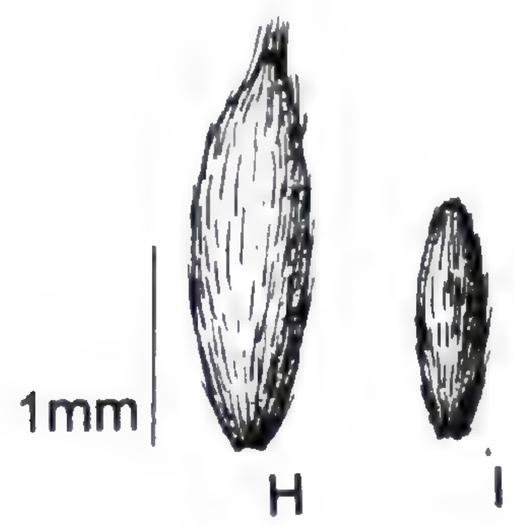
EGERIA PLANCHON

The genus *Egeria* consists of two partly sympatric species, both described by Planchon in 1849. St. John (1961) published a monograph of the genus as well as additional taxonomic studies (St. John, 1962, 1967). A more recent and complete taxonomic revision was published by Cook and Urmi-König (1984), who considered two species, *E. densa* Planchon and *E. najas* Planchon. *Egeria* is morphologically distinguished from other Hydrocharitaceae mainly by its paired scale leaves at the base of lateral shoots; intravaginal squamules with entire margins; unisexual flowers; petals much exceeding the sepals; nectaries on male flowers and staminodia on female flowers that are yellow to orange. According to Cook and Urmi-König (1984) the genus occurs from southeastern Brazil (Minas Gerais and Espírito Santo) to Uruguay, Paraguay, and Argentina. Both *Egeria* species are separated principally by the shape of the filaments and nectaries of the male flowers and by the shape of the staminodia of the female flowers. Recently, two new occurrences of *E. najas* were recorded for the Brazilian states of Mato Grosso do Sul (Pott & Pott, 1997) and São Paulo (Lidyanne Aona, pers. comm.).

Egeria heterostemon S. Koehler & C. P. Bove, sp. nov. TYPE: Brazil. Goiás: Estrada Aruanã–Goiânia, 19 km from Aruanã, 29 May 1997 (fl), *C. P. Bove, S. Koehler & J. Morrey-Jones 225* (holotype, RB; isotypes, CPAP, HUEFS, HUNI, MBM, MO). Figure 1A–G.

Herba dioica aquam dulcem habitans, caule irregulariter ramoso. Folia opposita vel verticillata interdum prope basin alterna, saepe curva, sessilia, linearia, 6–8 mm longa, ca. 1 mm lata. Flores emersi; sepalis 3, liberis, viridibus; petalis 3, liberis, albis. Flores masculi gemini; androecio ex staminibus dimorphis 9 in verticillos alternos 3 dispositis constante, filamentis verticillorum externi et medii glabris, erectis, a basi ad apicem gradatim angustatis eis verticilli interni claviformibus recurvatis supra pilosis; pollinis granis sphaericis, inaperturatis, spinosis; nectario solitario centrali. Flores feminei solitarii; staminodiis claviformibus, 1–1.5 mm longis, stipitem ca. 0.7 mm longum includentibus, stylis 3, 2 vel 3 fissis, nectarium ad basim gerentibus.

Dioecious, submerged or partially emerged, freshwater herbs. Stems monomorphic, elongate, irregularly branched, 0.5–1.3 mm diam. with internodes 1–5 mm long. Prophylls paired, deltate, 1.5–2 × 1–1.5 mm. Leaves opposite or whorled, sometimes alternate near the base, frequently recurved,



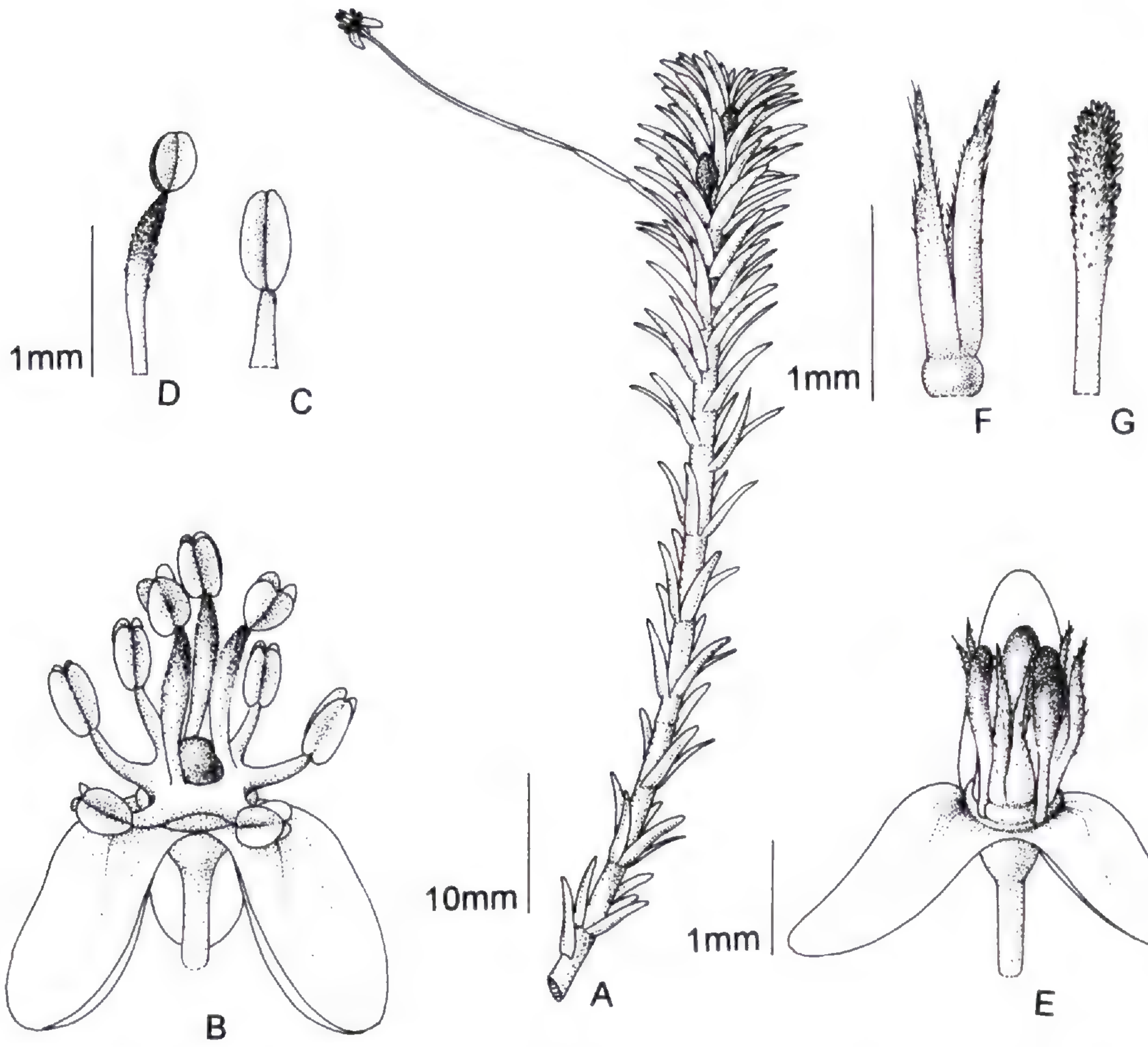


Figure 1. A–G. *Egeria heterostemon* S. Koehler & C. P. Bove. —A. Habit. —B. Male flower. —C. Stamen of outer whorl. —D. Stamen of inner whorl. —E. Female flower. —F. Style. —G. Staminode. (Drawn from the holotype, *Bove, Koehler & Morrey-Jones 225.*) H, I. *Apalanthe granatensis* (Humboldt & Bonpland) Planchon. —H. Seed (*Costa, Pupo & Araújo s.n.*). —I. Seed (*Bove, Costa & Muratori 114*). Drawn by Eduardo H. P. Kickhöfel.

sessile, linear, gradually attenuate to an acute apex, 6–8 × 0.5–1.0 mm, in whorls of 4 to 10 on sterile nodes; margins and apex bearing unicellular, thick-walled prickle-hairs, 0.7–1 mm long. Intravaginal squamules usually 2 in each leaf axil, ovoid to orbicular, 0.1–0.2 × 0.05–0.1 mm. Spathes axillary, sessile, ovoid, 5–10 mm long, with 2 apical teeth. Male flowers: 2 in each spathe, rarely more, pedicels up to 40 mm long, borne above the water surface; sepals 3, free, green, ovate and boat-shaped, 2 × 1 mm; petals: 3, free, white, delicate, suborbicular, 2.5–4 × 2–3 mm; stamens 9, in alternate whorls of 3, free; outer and median whorls: filaments glabrous, erect, broad at the base, attenuate to the apex, 0.3–0.5 mm long, anthers basifixed, 0.4–0.6 mm long, opening by longitudinal slits; stamens in outer whorl usually smaller than those of median whorl, although similar in form. Inner whorl: filaments clavate, erect, strongly pilose distally, apically constricted below the anther, 0.8–1 mm long; anthers basifixed, 0.3–0.5 mm long, opening by longitudinal slits. Pollen grains large,

shed as monads, (58–)70(–80) μm diam., spherical, inaperturate, echinate, surface granulose between spines, spines 3.5 μm long, exine ca. 1 μm thick. Nectary 1, central, 3-lobed, 0.2 mm diam., with lateral lobes shorter than the central lobe. Female flowers: 1 in each spathe, borne above the water surface, sessile; sepals 3, free, green, ovate and boat-shaped, 2 × 1 mm wide; petals 3, free, white, delicate, suborbicular, 3 × 2 mm; staminodes clavate, strongly papillose distally, 1–1.5 mm long, including a stalk up to 0.7 mm long; ovary inferior, ovoid, up to 3 mm long, attenuate above in an elongated free hypanthium, 10–35 mm long, 3-carpellate, 1-locular, with ca. 30–40 ovules with parietal placentation; styles 3, two-thirds divided along length, 1–2 mm long. Fruit unknown.

Distribution and habitat. Median Araguaia River region in the states of Mato Grosso and Goiás, in central Brazil, along stream margins and in swampy environments.

Phenology. Flowering was recorded for the months of May and October. As previously recorded for this genus (St. John, 1961; Cook & Urmi-König, 1984), male individuals were strongly predominant in the two populations investigated by us in Goiás.

Egeria heterostemon is distinguished from other *Egeria* species by its flowers having two different forms of stamens: the outer and median whorls of stamens have clavate and strongly papillose filaments, while the inner whorl stamens have attenuate and glabrous filaments. The other *Egeria* species have stamens with filaments either clavate and strongly papillose (*E. densa*) or elongated and glabrous (*E. najas*). Staminodes are clavate, rounded toward the apex, strongly papillose distally, and bearing a long stalk (ca. 0.7 mm). Staminodes of *E. densa* are also clavate and strongly papillose distally, but somewhat more attenuate to the apex and bearing a shorter stalk (only to 0.2 mm), while *E. najas* presents staminodes of cylindrical form, which are weakly papillose, with a truncate apex, and no stalk.

Paratypes. BRAZIL. **Mato Grosso:** Estrada Água Boa–Cocalinho a 148 km de Água Boa, 12 Oct. 1997, *C. P. Bove 273a, S. Koehler & J. Morrey-Jones* (HUNI, RB).

Apalanthe Planchon

The genus *Apalanthe* was described by Planchon in 1848 considering the species known as *Elodea guyannensis* L. C. M. Richard. Earlier, Humboldt and Bonpland (1813) had described the same species as *Elodea granatensis*. *Elodea guyannensis* was effectively published only in 1814, although the publication was dated 1812 (see Cook, 1985). Later, the genus was reduced to a subgenus of *Elodea* by St. John (1963), based on the presence of bisexual flowers. A taxonomic revision published by Cook (1985) reinstated the genus *Apalanthe*, considering vegetative, reproductive, and anatomical characters. It is distinguished morphologically from *Egeria* principally by its bisexual flowers, three stamens in one whorl, prophylls free and lateral or oblique, leaves without idioblasts, and leaf margins with fiber cells. The distribution of *Apalanthe* extends from northern South America (Ecuador to French Guyana), Bolivia, and Brazil, with a southernmost limit of distribution in the states of Rio de Janeiro and São Paulo (Cook, 1985).

Plants collected on field expeditions in the central regions of Brazil showed that fruits and seeds of *A. granatensis* present greater morphological variation than previously described by Cook (1985). According to his work, its fruits are about 5 mm long and contain ca. 6 to 7 seeds that are 2.8–4.5 mm long (including the micropylar beak), with the micropylar beak 0.8–1.5 mm long. These are covered with unicellular hairs ca. 0.8 mm long (Fig. 1H). The specimens collected in two different locations at the Araguaia River region possess larger fruits, 7–13 mm long, with seeds both smaller (1–1.3 mm) and more numerous (25 to 30). Further, these seeds present a reduced micropylar beak (only ca. 0.1 mm long) and shorter unicellular hairs (0.2–0.3 mm long) (Fig. 1I). All other vegetative and reproductive characters correspond to previous descriptions of *A. granatensis*, and, therefore, the new taxonomic data obtained do not justify the description of a new species of *Apalanthe*. The description of an infraspecific category is also not justifiable, since morphological variation, as well as ecological aspects of this species, is still very poorly known. The specimens were found only in swampy environments. Flowering was recorded for the months of February, May, and October. Plants of *Egeria heterostemon* and *A. granatensis* occur sympatrically in the states of Mato Grosso and Goiás (Brazil). In the Estrada Água Boa–Cocalinho (Mato Grosso) both species were collected in the same locality, growing together in intermingled populations. Vegetative distinction can be made by the prophylls as well as by anatomical features cited above.

Specimens of Apalanthe granatensis examined. BRAZIL. **Bahia:** Paratinga, 14 Feb. 1999 (fl, fr), *Costa, Pupo & Araújo s.n.* (CPAP, HUEFS, HUNI, MBM, MO, RB). **Mato Grosso:** C. do Rosário, Forquilha do Rio, Mar. 1918 (fr), *Kuhlmann 1620* (R); Estrada Água Boa–Cocalinho, 148 km from Água Boa, 12 Oct. 1997 (fl), *Bove, Lisbôa & Koehler 273b* (HUNI, RB); Estrada Água

Boa–Rio das Mortes, 20 Feb. 1993 (fl), *Bove, Costa & Muratori 114* (CPAP, HUNI). **Minas Gerais:** Lagoa Santa, 1954 (fl, fr), *Smith 6707* (R); Lagoa Santa, 1954 (fl, fr), *Smith 6707* (R). **Goiás:** Tupiratins, Brasilândia, R. Feio, 20 Mar. 1976 (fl), *Hatschbach & Kummrov 38497* (MBM); Estrada Aruanã–Goiás, 8.8 km from Aruanã, 29 May 1997, *Bove, Koehler & Morrey-Jones 224* (RB). **Rio de Janeiro:** Estrada Rio–Teresópolis, Baixada Fluminense, 1 Oct. 1964 (fl, fr), *Hatschbach & Pereira 11473* (MBM).

The results presented here indicate that there are insufficient collections of *Apalanthe granatensis* in the central region of Brazil (as suggested by Cook, 1985), as well as for the genus *Egeria*. Considering that the aquatic flora of this region is poorly known, the distribution of the species considered in this study may be a much larger than currently known; more work is needed.

KEY TO *APALANTHE* AND *EGERIA*

1a. Flowers bisexual; stamens 3; prophylls free, lateral or oblique; leaves without idioblasts, leaf margins with fiber cells . . . . *Apalanthe granatensis*
1b. Flowers unisexual; stamens 9 (male flowers); prophylls united at base, median; leaves with transparent idioblasts, leaf margins without fiber cells.
2a. Stamens heterogeneous in form; staminodes clavate, ca. 1–1.5 mm long, with rounded apex and bearing a stalk (ca. 0.7 mm long) . . . . . *Egeria heterostemon*
2b. Stamens homogeneous in form, staminodes elongate, 0.4–2.4 mm long, without a stalk or clavate with an attenuated apex bearing a stalk up to 0.2 mm long.
3a. Leaves mostly in whorls of 4 at sterile nodes, usually spreading, somewhat longer and wider; filaments clavate, constricted below the anther, strongly papillose above; nectaries of male flowers with lateral lobes as long as or longer than central lobe; staminodia of female flowers clavate, with an attenuate apex and bearing a short stalk (ca. 0.2 mm long) . . . . . *Egeria densa*
3b. Leaves mostly in whorls of 5 at sterile nodes, usually recurved, shorter and thinner; filaments elongate, not constricted below the anther, weakly papillose above; nectaries of male flowers with lateral lobes shorter than central lobe; staminodia of female flowers elongate and truncate at the apex, without stalk . . . . . *Egeria najas*

Acknowledgments. We sincerely thank W. Costa for suggesting the exploration of the interesting and still undiscovered aquatic flora of the Araguaia basin as well as for collecting specimens for our study; the curators of the herbaria BHCB, CPAP, HUEFS, MBM, and R for sending material for our study; J. Zanol and P. Paiva for providing the equipment to prepare the illustrations; Eduardo H. P. Kickhöfel for the illustrations; and C. D. K. Cook, D. H. Les, and V. Bittrich for comments on the manuscript.

Literature Cited

Cook, C. D. K. 1985. A revision of the genus *Apalanthe* (Hydrocharitaceae). Aquatic Bot. 21: 157–164.

———. 1996. Aquatic Plant Book, 2nd ed. SPB Academic Publishing, The Hague, The Netherlands.

——— & K. Urmi-König. 1984. A revision of the genus *Egeria* (Hydrocharitaceae). Aquatic Bot. 19: 73–96.

Humboldt, A. & A. Bonpland. 1813. Plantae Aequinoctiales. . ..In ordinem digessit Amatus Bonpland, 2(16): 150, pl. 128.

Les, D. H., M. A. Cleland & M. Waycott. 1997. Phylogenetic studies in Alismatidae, II: Evolution of marine angiosperms (seagrasses) and hydrophily. Syst. Bot. 22: 443–463.

Planchon, J. E. 1848. Synopsis specierum *Anachardis* et *Apalanthes*. Ann. Mag. Nat. Hist., Ser. 2, 1: 85–88, pl. 8.

———. 1849. Sur L'*Anacharis alsinastrum*, plante anglaise supposée nouvelle avec un synopsis des espèces d'*Anacharis* et d'*Apalanthe* et des descriptions de quelques hydrocharidées nouvelles. Ann. Sci. Nat.(Paris), Sér. 3, 11: 79–80.

Pott, V. & A. Pott. 1997. Checklist das macrófitas aquáticas do Pantanal, Brasil. Acta Bot. Brasil. 11: 215–227.

St. John, H. 1961. Monograph of the genus *Egeria* Planchon. Darwiniana 12: 293–307.

———. 1962. Note on the fruit of *Egeria naias* Planchon. Darwiniana 12: 523.

———. 1963. Monograph of the genus *Elodea* (Hydrocharitaceae). Part 3. The species found in northern and eastern South America. Darwiniana 12: 639–653.

———. 1967. The pistillate flowers of *Egeria densa* Planchon. Darwiniana 14: 571–573.

Further Nomenclatural Innovations in World Campanulaceae

Thomas G. Lammers

Department of Biology and Microbiology, University of Wisconsin Oshkosh, Oshkosh, Wisconsin 54901, U.S.A. lammers@uwosh.edu

ABSTRACT. Four replacement names are required in Campanulaceae s.l. due to the principle of priority. Genera affected are *Codonopsis* Wallich, *Lobelia* L., and *Wahlenbergia* Schrader ex Roth.

Key words: Campanulaceae, *Codonoposis, Lobelia, Wahlenbergia.*

Work is drawing to a close on the checklist of world Campanulaceae s.l. Although six precursor papers effecting requisite nomenclatural innovations have already appeared (Lammers, 1995, 1998a, 1998b, 1999a, 1999b; Serra et al., 1999), four additional situations have come to light that require action. Each involves the principle of priority and is rectified by the validation of a replacement name. As in previous cases, none of the species is sufficiently well known or important to justify conservation of its currently used name.

Codonopsis hongii Lammers, nom. nov. Replaced name: *Codonopsis hirsuta* (D. Y. Hong) K. E. Morris & Lammers, Novon 9: 387. 1999; non (Handel-Mazzetti) D. Y. Hong & L. M. Ma, in H. W. Li & Z. Y. Zhu, Flora Sichuanica 10: 546. 1992, based on *Codonopsis limprichtii* var. *hirsuta* Handel-Mazzetti, Akad. Wiss. Wien, Math.-Naturwiss. Kl., Anz. 61: 169. 1924. Basionym: *Leptocodon hirsutus* D. Y. Hong, Acta Phytotax. Sin. 18: 246. 1980. TYPE: China. Xizang: Zayu, Shang Zayu Zhong Xiang A Zha, mixed forest on slope, 2500 m, *Qinghai-Xizang Exped. Team 73–1014* (holotype, PE not seen).

In a previous paper (Lammers, 1999b), the genus *Leptocodon* (Hooker f.) Lemaire was subsumed into *Codonopsis* Wallich. It was not realized that the new combination proposed for *Leptocodon hirsutus* was preoccupied. The name proposed here rectifies that oversight.

The new epithet honors Hong De-yuan (1936–) of Beijing, who originally described the species. He is Director of the Open Laboratory of Plant Systematics and Evolution; Professor at the Institute of Botany, Chinese Academy of Sciences; and a major figure in the development of modern botanical research in China (Anonymous, 1997). It is a privilege to recognize his many years of work on the systematics, evolution, and biogeography of the Campanulaceae by naming this member of the family in his honor.

Lobelia andrewsii Lammers, nom. nov. Replaced name: *Lobelia gracilis* Andrews, Bot. Repos. 5: pl. 340. 1803; non Salisbury, Prodr. Stirp. Chap. Allerton 129. 1796, nom. illeg., based on *Lobelia laurentia* L., Sp. Pl. 931. 1753. *Rapuntium gracile* (Andrews) C. Presl, Prodr. Monogr. Lobel. 21. 1836. *Dortmanna gracilis* (Andrews) Kuntze, Revis. Gen. Pl. 2: 972. 1891. TYPE: Great Britain. Clapham gardens, Aug. 1803, Andrews (1803), pl. 340 (holotype).

Lobelia gracilis var. *rosea* J. W. Loudon, Ladies' Flowergard. Ornam. Annuals 1: 164. 1840. *Lobelia gracilis* f. *rosea* (J. W. Loudon) E. Wimmer, Pflanzenr. IV.276c: 563. 1953. TYPE: Great Britain. Forrest's Kensington nursery, Loudon (1840), pl. 29 fig. 6 (holotype).

Lobelia gracilis var. *major* Bentham, Fl. Austral. 4: 125. 1868. TYPE: Australia. Crevices of rocks, Mount Lindsay, *W. Hill s.n.* (holotype, K not seen).

This annual Australian species has long been known by a name that is a later homonym. It is renamed in honor of its author, English botanical painter and engraver Henry C. Andrews (fl. 1799–1830), publisher of the illustrated *Botanist's Repository.*

Wahlenbergia orae Lammers, nom. nov. Replaced name: *Wahlenbergia littoralis* Schlechter & Brehmer, Bot. Jahrb. Syst. 53: 127. 1915; non (Labillardière) Sweet, Hort. Brit. (ed. 2) 593. 1830, based on *Campanula littoralis* Labillardière, Nov. Holl. Pl. 1: 49. 1805. TYPE: South Africa. Beim Keiberg, im Gestrüpp, 6 Jan. 1895, *R. Schlechter 6195* (holotype, B not seen).

This Cape Province endemic has been known for many years by a name that is a later homonym. The new epithet is the genitive singular of the Latin

noun *ora*, coast, and was selected to preserve the meaning of the original epithet.

Wahlenbergia thulinii Lammers, nom. nov. Replaced name: *Lightfootia oppositifolia* A. DC., Monogr. Campan. 115. 1830; non *Wahlenbergia oppositifolia* A. DC., in DC., Prodr. 7: 429. 1839. TYPE: South Africa. Cape Province, Table Mt., *W. Burchell 606* (holotype, G-DC not seen; isotype, K not seen).

Lightfootia capillaris H. Buek, in Ecklon & Zeyher, Enum. Pl. Afric. Austral. 372. 1837. *Wahlenbergia capillaris* (H. Buek) Lammers, Taxon 44: 335. 1995; non (Loddiges) Sweet, Hort. Brit. (ed. 2) 593. 1830, based on *Campanula capillaris* Loddiges, Bot. Cab. 15: pl. 1406. 1829. TYPE: South Africa. Caledon, Genadendal, *C. Ecklon & C. Zeyher 2342* (holotype, S not seen; isotype, SAM not seen).

When I transferred the southern African species of *Lightfootia* L'Héritier, nom. illeg., to *Wahlenbergia* Schrader ex Roth (Lammers, 1995), I was unable to take up the epithet of *L. oppositifolia* in the new genus as the resulting combination was preoccupied. Instead, I took up the epithet of the earliest name treated as a synonym of that species, *L. capillaris*. To my regret, I subsequently discovered that this epithet likewise has already been used in *Wahlenbergia*, necessitating the creation of a replacement name.

The new epithet honors distinguished Swedish botanist Mats Thulin (1948–) , professor at Uppsala University, who has devoted over 20 years to the study of African Campanulaceae. His exemplary monograph of the tropical African species of *Wahlenbergia* (Thulin, 1975) has contributed greatly to our understanding of this large and complex genus. It is a pleasure to recognize his distinguished career by naming this member of the genus in his honor.

Acknowledgments. I extend my thanks to my colleague, Neil A. Harriman, who reviewed a copy of the manuscript prior to submission.

Literature Cited

Andrews, H. C. 1803. The Botanist's Repository, for New, and Rare Plants, vol. 5. T. Bensley, London.

Anonymous. 1997. New corresponding members of the society elected. Pl. Sci. Bull. 43: 59.

Lammers, T. G. 1995. Transfer of the southern African species of *Lightfootia*, nom. illeg., to *Wahlenbergia* (Campanulaceae, Campanuloideae). Taxon 44: 333–339.

———. 1998a. New names and new combinations in Campanulaceae. Novon 8: 31–35.

———. 1998b. Review of the neotropical endemics *Burmeistera*, *Centropogon*, and *Siphocampylus* (Campanulaceae: Lobelioideae), with description of 18 new species and a new section. Brittonia 50: 233–262.

———. 1999a. Nomenclatural consequences of the synonymization of *Hypsela reniformis* (Campanulaceae: Lobelioideae). Novon 9: 73–76.

———. 1999b. A new *Lobelia* from Mexico, with additional new combinations in World Campanulaceae. Novon 9: 381–389.

Loudon, J. W. 1840. The Ladies' Flower-garden of Ornamental Annuals, part 1. William Smith, London.

Serra, L., M. B. Crespo & T. G. Lammers. 1999. *Wimmerella*, a new South African genus of Lobelioideae (Campanulaceae). Novon 9: 414–418.

Thulin, M. 1975. The genus *Wahlenbergia* s. lat. (Campanulaceae) in tropical Africa and Madagascar. Symb. Bot. Upsal. 21(1): 1–223.

Two New Species of Passionflower (*Passiflora*, Passifloraceae) from Southwestern Mexico

John M. MacDougal
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63116-0299, U.S.A.

ABSTRACT. Two new species of passionflower vine (*Passiflora*, Passifloraceae) from southwestern and southern Mexico are described and illustrated. *Passiflora mcvaughiana* and *P. manantlanensis*, both in subgenus *Decaloba* (DC.) Reichenbach, belong to sections *Cieca* (Medikus) DC. and *Decaloba*, respectively. This brings the number of named native species of *Passiflora* recognized in Mexico to 68, with 21 native to the southwestern area known as Nueva Galicia.

Key words: Mexico, Nueva Galicia, *Passiflora*, Passifloraceae.

Revision of collections for a treatment of the Passifloraceae of Mexico, of which *Passiflora* is the only genus present, has shown that approximately 10% of the 68 native species remain undescribed. Two new species from the subtropical and temperate mountains of southwestern Mexico are described here in preparation for a treatment of the family for *Flora Novo-Galiciana* (MacDougal, in prep.). The first of the new species treated here has been known from collections for two centuries, but is only now being recognized. The other was collected during studies of the flora of the Manantlán region (Vázquez et al., 1995).

Passiflora mcvaughiana J. MacDougal, sp. nov. TYPE: Mexico. México: Mpio. Temascaltepec, N of Temascaltepec on rte. 134, ca. 11 mi. S of road to Tequesquipán, 6200 ft., oak woods, 24 Aug. 1978 (fl), *MacDougal 369* (holotype, DUKE; isotypes, IBUG, MEXU). Figures 1, 2.

Passiflora scandens ad sectionem *Ciecam* pertinens. Folia transverse oblonga leviter peltata biloba petiolis eglandulosis vel biglandulosis; nectariis in lamina nullis; lobis acutis, venis lateralibus angulum (125–)140–190° inter se formantibus. Inflorescentia bracteis nullis vel bractea setacea solitaria praedita. Flos colore pallide viridi-flavo; petalis nullis; coronae filamentis biseriatis, exterioribus 5.5–6.7 mm longis; operculo plicato; ovario glabro. Fructus ex bacca purpurea parva constans; seminibus 5.0–6.2 mm longis, 4.0–4.7 mm latis, foveolato-reticulatis.

Low-climbing herbaceous perennial vine (0.5–) 1–3 m, rarely to 8 m, appearing glabrous but actually sparsely pubescent with unicellular trichomes 0.3–0.8 mm long on stem near nodes, petiole, base of lamina, and main veins of lamina, also lightly and microscopically puberulent throughout with antrorsely appressed curved sausage-shaped trichomes. Stem terete, drying subangulate, becoming corky with age; actively growing shoot tips straight, not cernuous. Prophyll of the vegetative ramifying bud 1, acutely 3(–5)-lobed. Stipules 5–7.5 mm long, 0.4–1.0 mm wide, narrowly linear-lanceolate. Petioles 1–4(–5.5) cm long, eglandular or with one or two saucer-shaped nectary glands 0.5–2 mm diam., the glands then 0.55–0.75(–0.85) the distance from the base toward the apex of the petiole. Laminas 1–4(–7.5) cm long along central vein, 6–18(–23) cm wide, peltate 1–5(–7) mm from margin, transversely elliptic to transversely narrowly elliptic (widely divaricately bilobed), ratio of width to central lobe length 3.3–6.5(–9.0), radiately ca. 5-nerved, with a major vein going to the point of each lateral lobe, and a central vein extending to the truncate margin or into a short deltoid or obtusely pointed obsolete lobe, coriaceous, sometimes variegated along the main veins, the margins entire and hyaline, the lateral lobes acute, the angle between the primary lateral veins (125–)140–175 (–190)°, the ratio of lateral to central lobe length 1.7–4.5; laminar nectaries always absent. Peduncles (1)2 per node, uniflorous, (9–)12–35(–50) mm long; bracts absent or sometimes 1, setaceous, less than 1 mm long. Distinct inflorescence sometimes present on older plants, with flowers borne on an axillary condensed shoot at least 8 cm long with aborted laminas. Flowers ca. 1.5–2 cm diam., pale greenish yellow, the floral stipe (pedicel distal to articulation) 3.5–7 mm (to 9 mm in fruit); hypanthium 8–9 mm diam.; sepals 8–10 mm long, 4.5–6.3 mm wide, ovate-triangular, reflexed at anthesis, pale yellowish green; petals none; filamentous corona in 2 series, the outer series 5.5–6.7 mm long, filiform to linear, spreading upward and outward at ca. 45°, pale yellow, with purplish hue on the proximal half, the inner series 2.5 mm long, suberect, capitellate-dilated at apex; operculum 2 mm long, membranous, plicate; limen (disk) 6 mm diam., speckled with purple, its raised edge slightly in-

clined away from the column; staminal filaments connate 4–5 mm along androgynophore, the free portions 3–3.5 mm long; anthers 2.3 mm long; ovary 2–2.5 mm long, 1.7–2 mm wide, widely obovoid, glabrous; styles 4–5 mm long including capitate stigmas. Fruit 10–14 mm long, 10–13 mm wide, subglobose, lacking stipe, glabrous, bluish black with glaucous bloom; mature arils ca. 3 mm long, whitish, translucent, loosely fitting over the basal ⅓ to ½ of seed, tough, not gelatinous; seeds 2–10 per fruit, (5.0–)5.5–6.2 mm long, 4.0–4.7 mm wide, 2.4–3.0 mm thick, widely obovate, campylotropous, foveate-reticulate with 12–18 foveae, the edges of the pits often forming 1 or 2 longitudinal ridges, the chalazal beak broadly and bluntly conical, nearly erect to slightly inclined toward raphe.

Ecology. Moist hillsides and barrancas, in oak, oak-pine, or pine forest, or montane mesophytic forest with *Alnus, Carpinus, Clethra, Ardisia, Tilia, Podocarpus, Magnolia, Meliosma,* (1100–)1500–2000 m, flowering June–October, fruiting July–November.

Passiflora mcvaughiana is one of the two species that were reported from southwestern Mexico by Killip (1938) under the name of *Passiflora coriacea* Jussieu. The other was *P. obtusifolia* Sessé & Mociño, extremely similar vegetatively to the new species and probably its sister species. All these belong to section *Cieca* (Medikus) DC., the apetalous group of *Passiflora. Passiflora mcvaughiana* is distinguished from *P. coriacea,* which does not occur in southwestern Mexico, by the few-seeded fruits with large seeds, lack of laminar nectaries, and petiolar nectaries often absent. The diagnostically large seeds are the largest in section *Cieca*; in contrast, the seeds of the closely related *P. obtusifolia* are obovate and 3.9–4.4(–5.0) mm long by 2.1–2.8(–3.2) mm wide. Petiolar glands number 0–2, and their presence is often polymorphic within one individual. The outer corona is thicker and much longer than in *P. obtusifolia* (see Fig. 2), a species of lower elevations. Leaves from non-fertile or pre-reproductive nodes on the middle part of the plant have longer petioles, are more obviously peltate, are longer and wider, and have a narrower angle between the lateral veins; these leaves are represented in the extremes of the leaf measurements given above.

The name "Passiflora mcvaughii" [MacDougal ex Klucking] was invalidly published with only an English description (of foliar features), an illustration of a leaf, and the citation of [MacDougal] *369,* the type-collection of *P. mcvaughiana* (Klucking, 1992). The leaf illustrated is a very unusual variation, being transversely 4–5-lobed; this leaf came from the lower part of a sterile shoot.

This new species is not rare at higher elevations from Jalisco, spottily all the way perhaps to Oaxaca. Liebmann's "Rio Hondo" collection was probably made in the Distrito de Miahuatlán of Oaxaca, for in October 1842 Liebmann traveled from Ciudad Oaxaca southward to the coast (G. Tucker, pers. comm.). This species was cited as "*Passiflora* sp. nov. 2" in Vázquez et al. (1995: 211). At the type locality in México, it is associated with *P. pavonis* Masters.

McCormick (1982: 191) screened leaf samples of *MacDougal 369GR* for flavonoids, and found no detectable levels of *C*-glycosylflavones or flavonol 3-*O*-glycosides, the latter often found in other members of section *Cieca,* though not in her test of the putative sister species, *P. obtusifolia.*

Passiflora mcvaughiana was first collected by the Royal Botanical Expedition to New Spain two centuries ago. It is a great pleasure to name this new species in honor of Rogers McVaugh (b. 1909) for his contributions to our understanding of the history of botanical exploration in Mexico and of tropical botany in general. His many fine collections and detailed observations with rich label data allowed me to explore and re-collect populations of passionflowers across Mexico during my field studies of 1978–1980, resulting in many discoveries.

Paratypes. MEXICO. Locality unknown: *Sessé & Mociño 4457* [annotated "Passiflora peltata N."], (F, frags; MA 2 sheets, F neg. nos. 47343, 47344); *Sessé & Mociño 4458* [annotated "Passiflora pusilla N."], (F, frag; MA, F neg. no. 47345). **Guerrero:** near river in bottom of gorge near Omiltomi [Omiltemi], 6300 ft., 26 Oct. 1944 (sterile), *Sharp 441532* (MEXU). **Jalisco:** cañada que sube al Filo de la Vaca, por la toma de agua, El Zarzamoro, 1980 m, 22 July 1992 (fr), *Cuevas & Guzmán 4198* (CHAPA); Arroyo San Campus, Sierra Manantlán Occidental, 1–2.5 km distancia aérea al SW del Rincón de Manantlán, entre el puente rústico y el cañón, 19°35′30″N, 104°13′30″W, 1560–1620 m, 4 Jan. 1985, *Judziewicz & Guzmán 5080* (IBUG, WIS (2)); San Sebastián [del Oeste], trail to El Ranchito, 1500 m, 10 Jan. 1927 (sterile), *Mexia 1448* (CAS, F, UC, US [US sheet cited by Killip as *P. coriacea, Mexia "1148"*]); Sierra de Manantlán, S & W of the divide between Aserradero San Miguel Uno and Durazno, moist barranca above stream, pine forest zone, 1700 m, 7 Nov. 1952 (sterile), *McVaugh 14008* (MICH); Mpio. Talpa, km 22, brecha from El Tuito to Cuale, 1100 m, 20 Feb. 1990, *Ramírez Delgadillo & Pérez de la Rosa 1976* (IBUG); Cuautitlán, 2–3 km al NW de Telcruz, 1500 m, 13 Nov. 1991 (fr), *Santana et al. 5544* (WIS). **México:** Distr. Temascaltepec, Rincón, [19°01′N, 99°58′W], 1960 m, 27 Dec. 1932 (fl, fr), *Hinton 3030* (ASU, BM, DES, K, NY, US); Distr. Temascaltepec, Rincón, "canal bank," 2000 m, 19 Sep. 1933 (fl, imm. fr), *Hinton 4655* (BM, K, MEXU, S); Mpio. Temascaltepec, clones of type-collection cultivated at Duke University 1978–1981, *MacDougal 369GR*

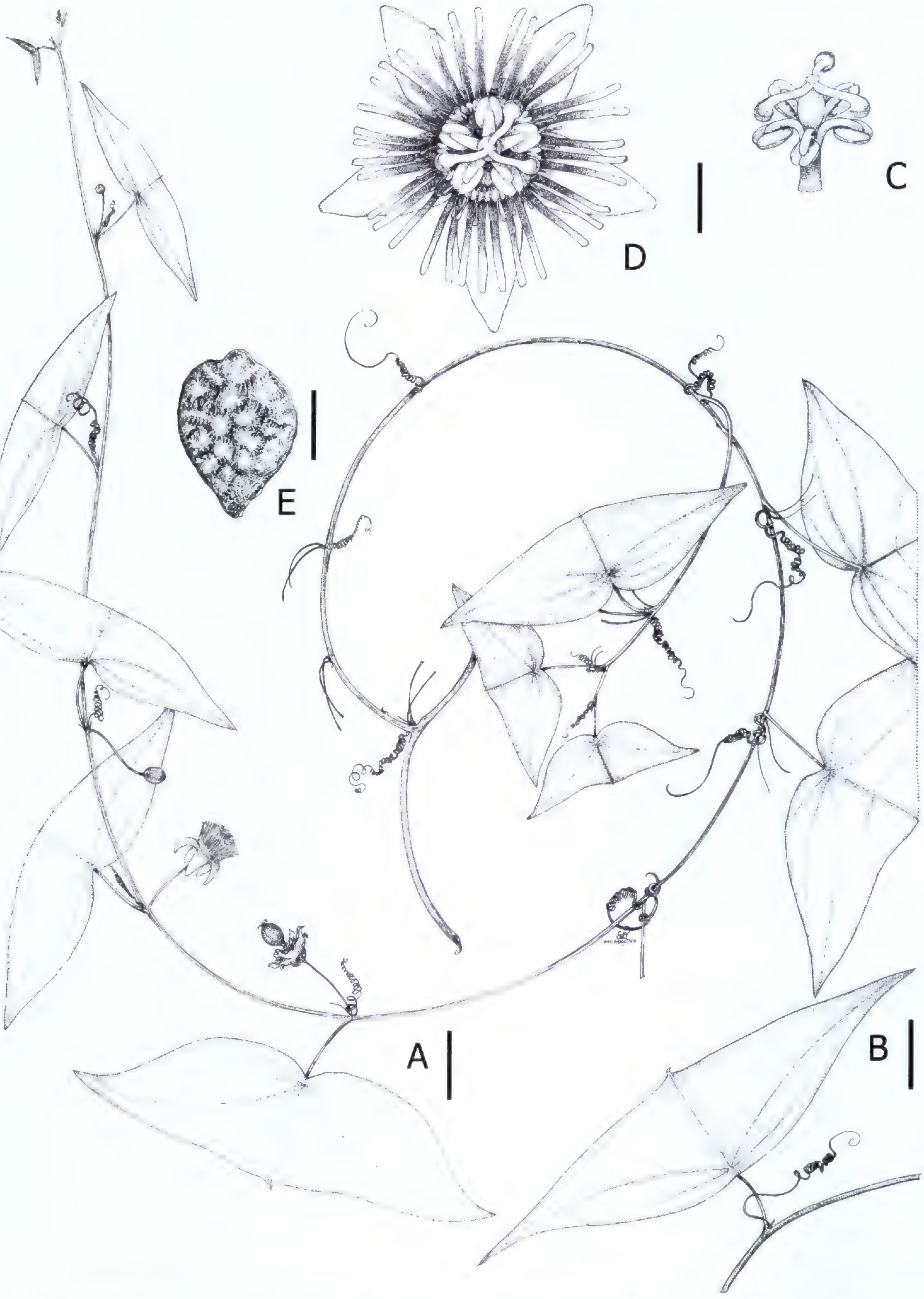


Figure 1. *Passiflora mcvaughiana* J. MacDougal. —A. Flowering portion of vine (*MacDougal 369*). —B. Leaf from *McVaugh 14008*.—C. Floral column with stamens and pistil. —D. Flower. —E. Seed. C–E from *MacDougal 369GR*. Scale bars: A, B = 2.0 cm; C, D = 5 mm; E = 2.5 mm.

Figure 2. Flower of *Passiflora mcvaughiana* J. MacDougal compared to the closely related *P. obtusifolia* Sessé & Mociño. —Left, *Passiflora mcvaughiana* (*MacDougal 369GR*). —Right, *Passiflora obtusifolia* (*MacDougal & Miley 495GR*). Scale bar = 3 mm.

(DUKE, MICH, MO). **Oaxaca?:** [Distr. Miahuatlán?], Río Hondo, Oct. 1842 (fl), *Liebmann 4080 (Passiflora 3)* (C).

Passiflora manantlanensis J. MacDougal, sp. nov. TYPE: Mexico. Jalisco: 3–4 km al E de Corralitos, 19–20 km al SE de Autlán, 19°36′50″N, 104°16′07″W, 1650–1750 m, 2 Mar. 1988 (fl, imm. fr), *Cuevas & Núñez 2307* (holotype, IBUG no. 97289; isotypes, WIS, ZEA). Figure 3.

Passiflora scandens ad sectionem *Decalobam* pertinens. Folia biloba petiolis eglandulosis; lobis acutis, venis lateralibus angulum 30–60° inter se formantibus. Pedunculi (2–)3–9-flori; bracteis 2.7–13 mm longis, 1–10 mm latis, ambitu ovatis vel late lanceolatis, profunde 5–9-fidis vel -fissis. Flos colore perpallide viridi-flavo vel eburneo; coronae filamentis biseriatis, exterioribus 3–4 mm longis; operculo plicato; ovario dense pilosulo vel subglabro. Fructus ex bacca purpurea parva constans; seminibus (7)8–9-sulcatis.

Climbing herbaceous vine to at least 3 m, densely short-pubescent to pilosulous throughout with suberect and straight or slightly antrorse-curving unicellular trichomes (0.1–)0.4–1.0(–1.4) mm long. Stem slightly compressed, in cross section a shallow triangle with rounded edges, densely pilosulous; posture of shoot tip unknown. Prophyll of the vegetative ramifying bud 1, lanceolate. Stipules 4–9 mm long, 0.5–0.7(–0.9) mm wide, linear to linear-triangular, drying brownish. Petioles 1–2(–3) cm long, eglandular. Laminas (5.5–)7–15(–16.5) cm long in outline, 3.8–11(–14) cm long along central vein, 4–12(–14) cm wide at widest point, truncate-elliptic in outline, shallowly to usually deeply bilobed ⅕ to ½ the distance to the base of the lamina, central vein length always equal to or shorter than width of leaf, not variegated, the margins entire, the lateral lobes acute, rarely also abruptly rounded apically, the angle between the primary lateral veins (30–)35–55(–60)°, the ratio of lateral to central lobe length (1.2–)1.4–2.3, the central vein ending in a 1–5 mm long mucro, rarely a central lobe evident but then very much shorter than lateral lobes and nearly obsolete and obtuse or rounded; laminar nectaries absent. Peduncles (1)2 per node, (2)3–9-flowered, the primary axis (5–)8–15 mm long to the first branch, secondary axes (and tertiary axes, if present) 2–10 mm long, pedicels (ultimate branches below articulation of flower) 4–15 mm long; bracts 2.7–10(–13) mm long, (1–)1.5–8(–10) mm wide, ovate to widely lanceolate in outline, deeply 5–9-fid or -cleft, the center segment always much the longest. Flowers ca. 2–2.5 cm diam., very pale greenish yellow (*marfil, verde*) flushed centrally with dull violet, apparently facing above horizontal at anthesis; floral stipe (pedicel distal to articulation) absent or to 1 mm long in fruit; hypanthium ca. 4.5 mm diam.; sepals 8–12 mm long, 3–3.5 mm wide, narrowly lanceolate-oblong,

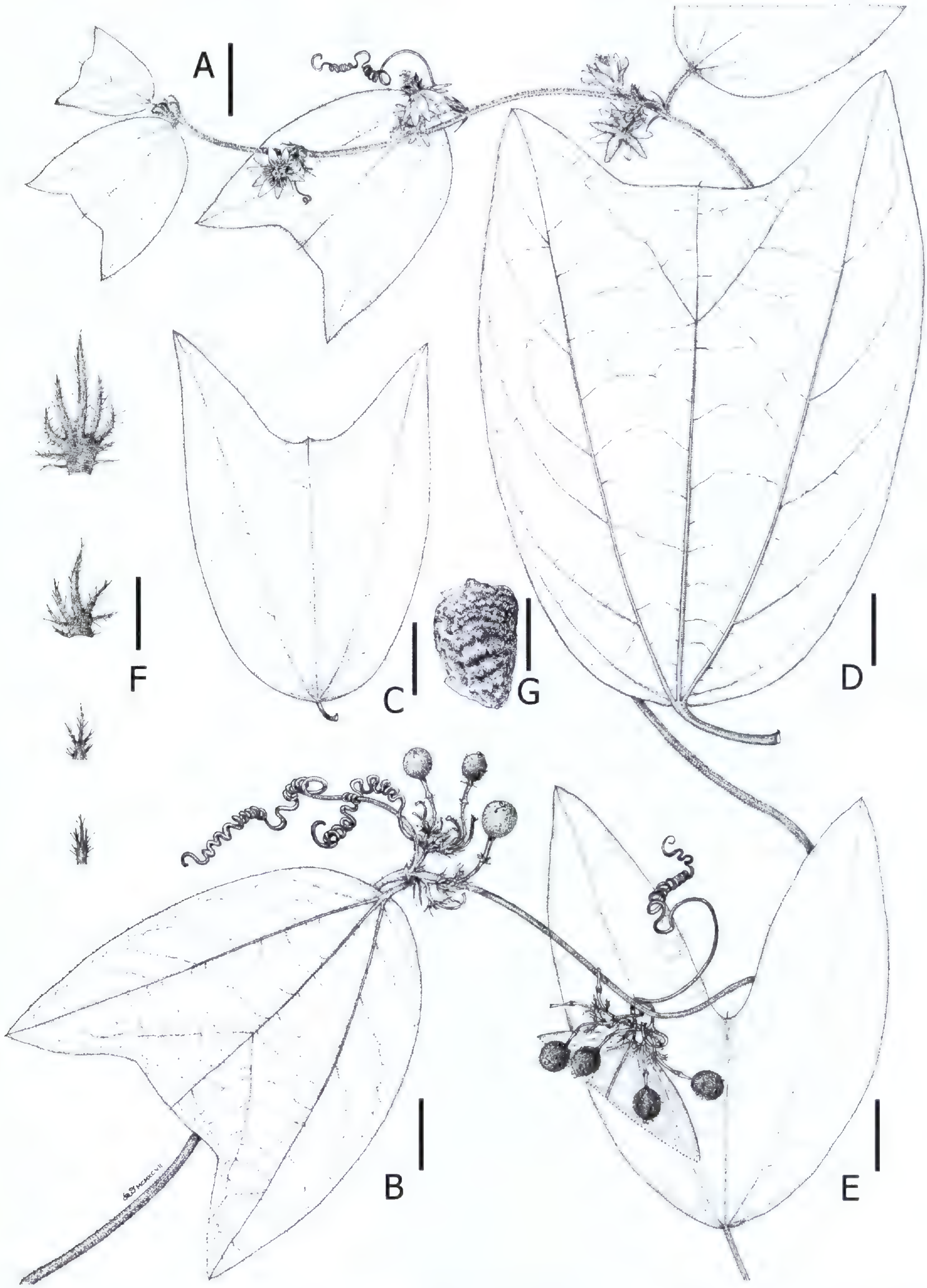


Figure 3. *Passiflora manantlanensis* J. MacDougal (all drawn from *Cuevas & Núñez 2307* except as noted). —A. Flowering portion of vine. —B. Fruiting portion of vine. —C. Leaf from *Vázquez 3953.*—D, E. Leaves from *Cuevas & Rosales 1914.*—F. Variation in four bracts from different positions in the same inflorescence. —G. Seed. Scale bars: A, B, C, D, E = 2.0 cm; F = 5 mm; G = 2 mm.

pale greenish yellow with flush of violet at base; petals 7–10 mm long, 1.5–2.5 mm wide, narrowly oblong, very pale greenish yellow or whitish, with flush of violet at base; filamentous corona in 2 series but only the outer one conspicuous, the outer series 3–4 mm long, filiform, slightly dilated distally, cream or pale yellowish, the inner series reduced in size and sometimes in number, 1–1.8 mm long, capitellate; operculum 1–1.8 mm long, membranous, plicate, tinged purplish, the margin erose-lacerate and papillate; limen (disk) 2.5 mm diam.; staminal filaments connate 4.5–7.0 mm along androgynophore (androgynophore appearing 4–6 mm long in fruit), the free portions 3.8–4.5 mm long; anthers 2.5 mm long; ovary very widely ellipsoid, densely pilosulous to very nearly glabrous, ovary ca. 2 mm long, 1.7 mm wide, the styles ca. 4.5 mm long including capitate stigmas. Fruit 1.2–1.5 cm long, 1.0–1.4 cm wide, widely ellipsoid to globose, lacking stipe, lightly pilosulous to glabrescent, purplish black when mature; arils unknown; seeds 3.3–3.7 mm long, 2.2–2.5 mm wide, 1.5–1.7 mm thick, elliptic to slightly obovate, nearly symmetric to slightly obcampylotropous, transversely sulcate with (7–)8–9 sulcae, the ridges verrucose, the chalazal beak suberect.

Ecology. Montane mesophytic forest, with *Podocarpus, Matudaea, Saurauia, Cornus, Conostegia, Ostrya,* or montane mesophytic forest mixed with tropical deciduous forest, with *Podachenium, Inga, Cleyera,* or mixed pine and oak forest, 1600–1900(–2300) m, flowering February–May, fruiting March–June.

Common names. *Pasionaria, pasiaria, pasión* (Jalisco).

Passiflora manantlanensis is assigned to subgenus *Decaloba* (DC.) Reichenbach section *Decaloba* on the basis of its eglandular petioles, bilobed leaf, plicate operculum, purple berry, and transversely sulcate testa. There it belongs to a small group of species that includes *P. sexflora* Jussieu, *P. porphyretica* Masters, *P. rugosissima* Killip, *P. malletii* MacDougal, and an unpublished new large-flowered species from Oaxaca, Mexico, represented by *LeDoux et al. 2308.* This species group is characterized by the absence of laminar nectaries, densely pubescent body, non-variegated leaves, relatively wide bracts, pale greenish yellow flowers with violet overtones, and small purple berries. Most of the species have branched peduncles. This new species is distinct from its close relatives by the narrow leaf lobe angle, deeper lobing, longer pubescence, and bract morphology. It has flowers similar to *P. porphyretica, P. rugosissima,* and variants of *P. sexflora.* It can be distinguished easily from *P. porphyretica* by its branched peduncles and smaller, cut bracts. It differs from *P. rugosissima* in its longer vestiture, narrower angle of the leaf lobes, usually shorter peduncles, and more deeply cut and usually smaller bracts. It differs from *P. sexflora* in its wider and more finely cut bracts, deeper lobing of leaf, longer vestiture, and shorter petioles, and it appears to have a more compressed stem. It has large leaves similar to the new species from Oaxaca, but more deeply lobed; the flowers are smaller and the bracts are smaller and deeply cut, not nearly entire. The relatively deeply bilobed leaf at maturity is unusual and the relatively narrow interlobe angle is unique in this species group.

In the one specimen from Guerrero, the bracts are notably larger and the flowers are smaller, and represent the upper and lower ranges, respectively, in the measurements given above. Although the label of every sample from the Sierra de Manantlán area notes that the plant was "frequent" or "abundant," this species and its ecology are very poorly known. The description of the flower was made from reconstituted wilted flowers at the base of immature fruits and the one flower known at anthesis, from *Pérez de la Rosa 1109.* This species was cited as "*Passiflora* sp. nov. 1" in Vázquez et al. (1995: 211).

Paratypes. **Guerrero:** Mpio. Atoyac, a 26 km al NE de El Paraíso, camino a Puerto del Gallo, 1650 m, 29 Mar. 1983 (fl, fr), *E. Martínez 3795* (MEXU, MO). **Jalisco:** Mpio. Cuautitlán, 3–4 km al SW de La Cumbre, camino al Durazno, 1800–1900 m, 6 Apr. 1987 (fr), *Cuevas & Rosales 1914* (WIS (3), ZEA); Mpio. San Sebastián del Oeste, Km 4 camino La Capilla–El Real Alto, 2300 m, 17 May 1986 (fr), *Pérez de la Rosa 1109* (IBUG); Mpio. San Sebastián del Oeste, brecha San Sebastián del Oeste–Mascota, 1800 m, 18 May 1986 (fl, fr), *Reyna B. 229* (IBUG); camino del puerto de La Moza al Casimiro Castillo, através de la barranca del Tecolote, Ejido de la Naranjera, 15 km al SSE de Autlan, 19°34′30″N, 104°20′30″W, 1600 m, 15 Feb. 1986 (fl, imm. fr), *A. Vázquez 3953* (WIS (2)).

Acknowledgments. NSF support for a fellowship during part of this investigation is gratefully acknowledged. I thank the curators of ASU, BM, C, CAS, CHAPA, DES, DUKE, F, K, IBUG, MA, MEXU, MICH, NY, S, UC, US, WIS, and ZEA for loans. Special thanks go to Rogers McVaugh for his assistance and inspiration, and to Hugh H. Iltis for hounding me to extoll the new find from Manantlán. Roy Gereau wrote the Latin descriptions. The excellent illustrations were drawn by Karin Douthit for Rogers McVaugh's *Flora Novo-Galiciana*; they are reproduced here with permission of the Uni-

versity of Michigan Herbarium, which retains copyright to both drawings.

Literature Cited

Killip, E. P. 1938. The American species of Passifloraceae. Publ. Field Mus. Nat. Hist., Bot. Ser. 19: 1–613.

Klucking, E. P. 1992. Leaf Venation Patterns, Vol. 6 (Flacourtiaceae). J. Kramer, Berlin.

McCormick, S. P. 1982. Flavonoid Chemistry of *Passiflora* subg. *Plectostemma*. Ph.D. Dissertation, Department of Botany, The University of Texas, Austin, Texas.

Vázquez G., J. A., R. Cuevas G., T. S. Cochrane, H. H. Iltis, F. J. Santana M. & L. Guzmán H. 1995. Flora de Manantlán. Sida, Bot. Misc. 13: i–xxxvii, 1–312.

Lectotypifications in the Genus *Tococa* Aublet (Melastomataceae)

Fabián A. Michelangeli

L. H. Bailey Hortorium, Department of Plant Biology, Cornell University, Ithaca, New York 14853, U.S.A. Present address: Department of Ornithology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024, U.S.A.
fabian@amnh.edu

ABSTRACT. Lectotypes for 11 species of *Tococa* are here designated, either because the holotypes were lost during the fire at Berlin and there are known extant isotypes, or because several syntypes were cited in the original descriptions. Three neotypes are here designated, since the holotypes are lost or destroyed and no isotypes have been located to date.

Key words: lectotypes, Melastomataceae, neotypes, *Tococa.*

As a result of a monographic study of the genus *Tococa* Aublet, a number of taxa have been found to be in need of lectotypification. None of the regional floras published in the last 70 years (Gleason, 1931a, 1931b; Gleason & Killip, 1938; Macbride, 1941; Wurdack, 1973, 1980, 1993; Michelangeli, in press) have addressed this problem, even though the existence of such a problem has been acknowledged at times.

Of the close to 100 taxa that have been associated with *Tococa*, 7 were described with numerous collections cited but with no holotype designated, because this was not a requirement at the time. Additionally, 4 species need lectotypification because their holotypes deposited at Berlin were destroyed during World War II, but there are known isotypes for these species deposited at other herbaria. Three neotypes are being designated because the holotype was destroyed or lost, and there are no known isotypes.

The lectotypes here designated have been chosen in order to assure that specimens are representative of the species and characters agree with the original description. Therefore, they do not always correspond to a specimen deposited at the herbarium in which the species author used to work.

Tococa broadwayi Urban, Feddes Repert. 17: 163. 1921. TYPE: Tobago: inter Charlotteville et Parlatuvier in sylvis umbrosis humidis, Nov., *Broadway 4281* (holotype, B destroyed). NEOTYPE: Venezuela. Sucre: Peninsula de Paria, Ladera Norte de Cerro de Humo, 14 km al N de Rio Grande Arriba, arriba de Boca de Cumana y Punto Siparo, Noroeste de Irapa, 1060 m, 1 Mar. 1966, *J. A. Steyermark 94999* (neotype, designated here, VEN; isoneotypes, F, US).

The holotype was destroyed during World War II, and there are no known photographs. Several other collections made by Urban are deposited at TRIN, but an extensive search by the curatorial staff of this herbarium failed to locate the cited specimen, or any collection of *T. broadwayi* by Urban. Due to the restricted distribution of this species (primary forests in Trinidad, Tobago, and the Paria Peninsula in northeastern Venezuela), very few specimens have been collected. The Steyermark specimen chosen as the neotype is not from the type locality, but it is one of the few collections that have all the characters listed in the original description.

Tococa capitata Trail ex Cogniaux, Fl. Bras. 14: 615. 1888. TYPE: Peru. Alto Amazonas: ad Januaria secus rio Purus, *Trail 288* (lectotype, designated here, K [photos at F, BH]; isolectotype, BR).

Two collections, *Trail 288* and *Trail 289*, are mentioned in the original description. *Trail 288* is chosen as the lectotype because it has flowers that correspond to the description in the protologue. *Trail 289* has only young fruits, and lacks many of the characters mentioned in the description, due to the advanced stage of the inflorescences.

Paratypes. PERU. Rio Jurna, floret Sep.–Oct., *Trail 289* (K).

Tococa caudata Markgraf, Notizbl. Bot. Gart. Berlin-Dahlem 9: 1146. 1927. TYPE: Ostperu: Mittlere Marañon, Mundung der Apaga, in flutfreien Hochwald, 145 m asl, 23 Dec. 1924, *Tessmann 4815* (holotype, B destroyed [photo at NY]). NEOTYPE: Peru. Loreto: Rio Nanay, 120 m, 4 Jan. 1976, *Gentry & Ayala 15549* (neotype, designated here, F; isoneotypes, AMAZ, MO, NY).

The holotype was destroyed during World War II, and no other specimens could be located at other herbaria in which Tessmann deposited his collections (BR, G, K). Even though the photograph of the type is of very good quality, several diagnostic characters of the calyx and the ovary are not discernible on it. Therefore, this photograph cannot be used as a photolectotype. The neotype designated here presents all the characters described in the protologue.

Tococa cordata Berg ex Triana, Trans. Linn. Soc. Bot. 28: 133. 1871. TYPE: Venezuela. Amazonas: San Carlos de Rio Negro, *Spruce 3477* (lectotype, designated here, K; isolectotypes, BR, K, NY).

Both collections *Spruce 2214* and *3477* are mentioned in the original description. One of the K specimens of *Spruce 3477* has both types of inflorescence described in the protologue, and, therefore, it is designated as the lectotype. It is important to point out that these two kinds of inflorescences represent different stages of development and not alternative forms.

Paratypes. BRAZIL. Necnon prope San Gabriel ad Rio Negro, *Spruce 2414* (K, P).

Tococa egensis Naudin, Ann. Sci. Nat., Bot., Ser. 3, 16: 92. 1851. TYPE: In Brasilia septentrionali, prope urbiculam Ega (now Tefé), *Poeppig 17202* (holotype, B destroyed [photos at F, NY]; lectotype, designated here, P).

The original description mentioned an unnumbered collection of Poeppig. However, as can be seen in the P specimen and in photographs of the B specimen, these specimens were annotated by Naudin with the number *17202* and referred to as types. The holotype, deposited at B, was destroyed during World War II. At M, where duplicates of most of Poeppig's collections are housed, there are several specimens of *T. egensis* but not one annotated by Naudin with the proper collection number. Therefore, the P specimen seems to be the only known isotype, and it is here designated as the lectotype.

Tococa erythrophylla (Ule) Wurdack, Mem. New York Bot. Gard. 10(5): 176. 1963. *Miconia erythrophylla* Ule, Notizbl. Gart. Berlin 6: 357. 1915. TYPE: British Guiana (now Guyana): am Abhang des Roraima, 2000 m asl., Feb. 1910, *Ule 8679* (holotype, B destroyed; isotype, K presumed lost). NEOTYPE: British Guiana (now Guyana): Partang River, Merume Mountains, upper Mazaruni river Basin, 3 July 1960, *Tillet, Tillet & Boyan 43984* (neotype, designated here, NY; isoneotypes, K, P).

The holotype, deposited at B, was destroyed during World War II. Wurdack (1993) stated that there is an isotype deposited at K, but an extensive search for this specimen at K, as well as in other herbaria, was unsuccessful. The neotype designated here presents all the characteristics mentioned in the original description and was originally determined by Wurdack, who presumably also had access to the original type at one point.

Tococa hirta Berg ex Triana, Trans. Linn. Soc. Bot. 28: 132. 1871. TYPE: Venezuela. Amazonas: necnon prope San Carlos ad Rio Negro, *Spruce 3145* (lectotype, designated here, K; isolectotypes, BR, P).

The two collections of Spruce are mentioned in the original description and are annotated by Berg. The specimen of *Spruce 3145* deposited at K is designated as the lectotype because it agrees with the description in the protologue and has the largest number of known duplicates. The specimen at P is labeled as both *Spruce 3145* and *Spruce 3564*, and therefore it seems prudent to assign the status of isolectotype to it.

Paratypes. VENEZUELA. **Amazonas:** Prope Tomo ad flumen Guainia v Rio Negro supra ostium fluminis Casiquiari, *Spruce 3564* (K).

Tococa juruensis Pilger, Verh. Bot. Vereins Prov. Brandenburg 47: 176. 1905. TYPE: Brazil. Amazonas: Unterer Juruá, Fortaleza, *Ule 5914* (holotype, B destroyed [photo NY]; lectotype, here designated, K; isotypes, G, L).

The holotype was deposited at B and destroyed during World War II. The K specimen is designated as the lectotype.

Tococa longisepala Cogniaux, Fl. Bras. 14(4): 449. 1888. TYPE: Brazil. Alto Amazonas: prope Panure ad Rio Uaupes, *Spruce 2446* (lectotype, designated here, P; isolectotypes, BR [fragment], K, P[2]).

Of the four different collections cited in the original description, *Spruce 2446* is the best preserved, has various duplicates, and has original annotations made by Cogniaux. Therefore, it is selected here as the lectotype.

Paratypes. BRAZIL. **Alto Amazonas:** in vicinia Manaos, *Spruce 1156* (P); Ad Ygarape da Cachoeira gran-

de, prope Manaos, *Schwacke III 342* (BR). **Rio de Janeiro:** *Glaziou 13831* (BR, K, P[2]).

Tococa macrophysca Spruce ex Triana, Trans. Linn. Soc. Bot. 28: 132. 1871. TYPE: Colombia. Prope Panure ad Rio Uaupes et S. Gabriel ad Rio Negro, in parte Orientali prov. Rio Negro, *Spruce 2188* (lectotype, designated here, K; isolectotypes, BR [fragment], K, P, W not seen).

Three different collections, all from the same locality, are cited in the original description, and all of them are consistent with the description. *Spruce 2188* is in good condition and has a drawing of a dissected flower, presumably by Spruce, and therefore it is designated as the lectotype.

Paratypes. COLOMBIA. Same localities, *Spruce 2825* (BR, G, K, P), *Spruce 2912* (K).

Tococa macroptera Naudin, Ann. Sci. Nat., Bot., Ser. 3, 16: 94. 1851. TYPE: Brazil. Goiás: *Gardner 3174* (lectotype, designated here, P; isolectotypes, BM, K[3], NY, P[2]).

Of the two collections mentioned in the description, Gardner's is designated as the lectotype because it is a well-preserved specimen, and it has a larger number of existing duplicates.

Paratypes. BRAZIL. **Central:** Sertao d'Amaroleité, *Wedell 2499* (P).

Tococa micrantha Ule, Notizbl. Bot. Gart. Berlin-Dahlem 6: 364. 1915. TYPE: Peru. Loreto: Sep. 1902, *Ule 6369* (holotype, B destroyed; lectotype, designated here, K; isotypes, F, G, L).

Since the holotype was destroyed during World War II, the best preserved isotype, which additionally has more reproductive structures, is chosen as the lectotype.

Tococa subglabrata Cogniaux, Fl. Bras. 14: 438. 1888. TYPE: Brazil. Piauhy, *Gardner 2862* (lectotype, designated here, P; isolectotypes, BR, K[2], NY, P[2]).

Of the different collections cited in the original description of *T. subglabrata*, *Gardner 2862* not only is the best preserved, but it also has the largest number of duplicates. Therefore it is chosen here as the lectotype. Additionally, *Riedel 1145* and *Pohl 3989* have not been located.

Paratypes. *Martius s.n.* (G), *Riedel 1145* (not seen), *Pohl 3989* (not seen).

Tococa ulei Pilger, Verh. Bot. Vereins Prov. Brandenburg 47: 177. 1905. TYPE: Peru. Loreto: *Ule 6200* (holotype, B destroyed [photos at F, NY]; lectotype, designated here, K; isotypes, G, L).

The holotype was destroyed during World War II. The K specimen is designated as the lectotype.

Acknowledgments. I thank the curators and staff of the following herbaria for allowing me access to their collections and/or for providing the loans, images, or information necessary for this study: B, BM, BR, CAS, F, FLAS, G, K, L, M, MER, MO, MYF, NY, P, TRIN, US, VEN, W, and WIS. Visits to BM, BR, K, MER, MYF, P, US, and VEN were possible thanks in part to support from the Andrew Mellon Fund from the L. H. Bailey Hortorium, grants to Eloy Rodriguez (Department of Plant Biology, Cornell University), and the American Society of Plant Taxonomists Graduate Research Awards. Jerrold Davis, Susanne Renner, and two anonymous reviewers provided comments that helped to improve this manuscript.

Literature Cited

Gleason, H. A. 1931a. Results of the Tyler-Duida expedition. Bull. Torrey Bot. Club 58: 277–506.

———. 1931b. Studies on the flora of northern South America—XV. Recent collections of Melastomataceae from Peru and Amazonian Brazil. Bull. Torrey Bot. Club 58: 215–262.

——— & E. P. Killip. 1938. The flora of mount Auyan-Tepui, Venezuela. Geogr. Rev. 28: 452–474.

Macbride, J. F. 1941. Melastomataceae. *In* Flora of Peru. Field Mus. Publ. Bot. 13: 249–523.

Michelangeli, F. A. In Press. *Tococa* (Melastomataceae). *In* P. E. Berry, B. K. Holst & K. Yatskievych. Flora of the Venezuelan Guayana, Vol. 6. Missouri Botanical Garden Press, St. Louis.

Wurdack, J. J. 1973. Melastomataceae. Pp. 1–819 *in* T. Lasser (editor), Flora de Venezuela. Vol. VIII. Instituto Botánico, Caracas.

———. 1980. Melastomataceae. Pp. 406 *in* G. Harling & B. Sparre (editors), Flora of Ecuador No. 13. University of Göteborg, Swedish Natural Science Research Council, Stockholm.

———. 1993. Melastomataceae. Flora of the Guianas, Series A Phanerogams 13: 3–301.

Three New Species of *Prosopidastrum* (Mimosaceae) from Argentina

Ramón A. Palacios and Patricia S. Hoc

Labs. 10 and 11, Depto. Cs. Biológicas, Pab. 2°, 4° piso, Facultad de Ciencias Exactas y Naturales, Ciudad Universitaria, 1428 Buenos Aires, Argentina

ABSTRACT. The genus *Prosopidastrum* (Mimosaceae) was described by Burkart on the basis of two species: *P. mexicanum* (Dressler) Burkart from Mexico with fruits 12 mm wide, dehiscing by two valves dividing into 1-seeded segments, these separating from a persistent replum, with leaflets 4–8 × 2–4 mm, and *P. globosum* (Gillies ex Hooker f. & Arnott) Burkart from Argentina, which has loments 3–4 mm wide and leaflets 0.5–2 × 0.5–1 mm. Burkart noted the Argentinean *P. globosum* as polymorphic. Based on fieldwork, analysis of herbarium specimens, and palynological studies, we concluded that three entities new to science must be described: *P. dehiscens*, *P. angusticarpum*, and *P. gracile*. The new species are restricted to Argentina and are mostly allopatric, but rarely locally sympatric. Characters of fruit, flowers, pollen, and leaves identify each new species. A key to differentiate all the known species is provided, as well as a key to identify the Argentinean species based on pollen morphology.

RESÚMEN. El género *Prosopidastrum* (Mimosaceae) fue descripto por Burkart con la base en dos especies: *P. mexicanum* (Dressler) Burkart de México con frutos de 12 mm de ancho, dehiscente por dos valvas y desarticulándose en segmentos uniseminados que se desprenden de un replum persistente, con folíolos de 4–8 × 2–4 mm, en tanto que *P. globosum* (Gillies ex Hooker f. & Arnott) Burkart presenta lomentos de 3–4 mm de ancho y folíolos de 0.5–2 × 0.5–1 mm. Burkart advirtió que la especie argentina era muy polimórfica. Después de realizar numerosas observaciones de campo, análisis de ejemplares de herbario y un estudio palinológico, arribamos a la conclusión de que tres nuevas entidades para la ciencia, diferentes de las ya conocidas para el género, deben ser descriptas: *P. dehiscens*, *P. angusticarpum* y *P. gracile*. Las tres nuevas especies se distribuyen exclusivamente en Argentina y son mayormente alopátricas, raramente en ciertas localidades son simpátricas. Las características del fruto, las flores, las hojas y el polen permiten identificar a cada nueva especie. Se proporciona una clave para diferenciar a todas las especies conocidas de *Prosopidastrum*, así como una clave para diferenciar a las especies argentinas con base en sus características palinológicas.

Key words: Argentina, Mimosaceae, *Prosopidastrum*.

During a revision of the genus *Prosopidastrum* for *Flora Fanerogámica Argentina* (Museo Botánico de Córdoba–Missouri Botanical Garden) we observed that several entities have been included under the name *Prosopidastrum globosum*. The genus was established by A. Burkart (1964), who studied exsiccatae from Mexico (Baja California) and Argentina (Occidental and Patagonian areas). He founded the new genus on the basis of fruit characters.

Prosopidastrum mexicanum is endemic to the Llanos de San Agustín area (Baja California, Mexico). Sensu Burkart (1964), *P. globosum* grows in Argentina from Catamarca province to northern Chubut; he pointed out that this species is polymorphic.

We studied herbarium specimens and type material analyzed previously by Burkart, and observed that some exsiccatae were incomplete or mixed collections. Subsequently, we carried out fieldwork studying topotypes, and floral, pollen, and fruit morphology. We therefore conclude that three entities exist separate from *P. globosum* and *P. mexicanum*, exhibiting different plant morphologies, geographic distributions, and pollen morphology.

DESCRIPTION OF THE NEW SPECIES

1. Prosopidastrum dehiscens R. A. Palacios & Hoc, sp. nov. TYPE: Argentina. San Juan: Depto. Calingasta, Ruta Provincial 141, de Tocota a Villanueva, ca. 7 km al N de Villanueva, 12 Feb. 1994, *R. A. Palacios, P. S. Hoc & M. A. Agulló 2550* (holotype, BAFC; isotypes, MO, SI). Figure 1A–C.

Haec species a *P. globoso* ramis hornotinis rectis, foliolis 2–4 × 0.8–2 mm, calyce pubescenti, non hirsuto; petalis dimidio superiore pilosis, non hirsuto-pubescenti,

Figure 1. A–C, *P. dehiscens* R. A. Palacios & Hoc. —A. Flower. —B. Leaf, at the base, stipules divergent and recurved with their glandular bases, between them the petiolar gland. —C. Fruit, seen from above, and lateral view

Table 1. Distinguishing features of Argentinean *Prosopidastrum* species.

Character	*P. dehiscens*	*P. angusticarpum*	*P. gracile*	*P. globosum*
Young branches	Rigid, not prickly	Divaricate, prickly	Fastigiate, not prickly	Flexuose, not prickly
Stipules	Deciduous, recurved or straight, not adpressed, not prickly	Persistent, recurved, not adpressed, prickly	Deciduous, straight, adpressed, not prickly	Deciduous, straight, adpressed, not prickly
Glandular base of stipules	Persistent glandular, hemispherical	Persistent glandular, connate	Persistent auriculate, ovate-triangular gland	Persistent glandular, hemispherical
Pinnae	1-foliolate, to 3 pairs of leaflets	Never 1-foliolate, 2–4 pairs of leaflets	1-foliolate	1-foliolate, to 3 pairs of leaflets
Leaflets	Thickened	Papyraceous	Thickened	Thickened
Flowers	Sessile	Pedicellate	Pedicellate	Sessile
Calyx	Thickened, pubescent	Membranous, glabrous	Membranous, glabrous	Thickened, hirsute
Petals	Thickened, pilose at distal portion, cucullate, incurved	Membranous, glabrous, recurved at the apex	Membranous, glabrous, recurved at the apex	Thickened, pilose at distal portion, incurved at the apex
Stamen length	4.5–6.5 mm	(5)6–7 mm	6–10 mm	3.5–6 mm
Fruit	40–70 × (4)5–8 mm, dehiscent by ventral suture, spreading, chestnut brown, pubescent	40–75 × 3–5 mm. indehiscent, spreading, grayish brown, pilose	90–210 × 5–8 mm, indehiscent, pendulous, straw-colored, pubescent with adpressed villous hairs	60–70 × 3–4 mm, indehiscent, pendulous, chestnut brown, pubescent with white and not adpressed hairs

legumine in sutura ventrali dehiscente 40–70 × (4)5–8 mm differt.

Shrub 0.5–3 m tall; homotinous (this year's growth) branches straight, rigid, pubescent, 3–4 mm diam. at base, not prickly, spreading at 20–90° to the axis, pubescent. Stipules 0.5–2 mm long, spinose, straight to recurved, divergent, pubescent, with persistent hemispherical glandular base. Leaves pubescent on both surfaces; petiole 0.5–1 mm long; petiolar gland circular and sessile; pinnae 1-foliolate or containing up to 3 pairs of leaflets and 0–5 mm long; leaflets 2–4 × 0.8–2 mm, thick, oblong to elliptic, obtuse at apex, truncate at base. Capitulae 10–15 mm diam., with (13)25–30 flowers; peduncle 8–13 mm long, pubescent; bracts broad and lanceolate, hirsute abaxially. Flowers sessile; calyx 1–1.3 mm long, white, green toward the apex, thick, tubular, pubescent, with very shallow triangular teeth; corolla 3.5–3.8 mm long, petals white in basal third, otherwise green, thick, incurved, cucullate, pilose abaxially (distal portion), with glandular papillae at apex; androecium 4.5–6.5 mm long, filaments white, short (exceeding petals for 1–2 mm), anthers broadly elliptic; ovary green, hirsute. Fruits 1 to 2 per infructescence, dehiscing by ventral suture, splitting partially between the seeds, 40–70 × (4)5–8 mm, spreading, straight, subwoody and acute at the apex, chestnut brown, pubescent; umbos contiguous with crests generally connate, semicircular to trapezoid in outline as seen from ventral suture. Pollen grains 3-colporate, spherical, amb circular. Exine perforate, pits 0.88 μm diam., surrounded by other pits 0.3 μm diam. (mean value). Colpi membrane granulate, borders granulate, irregular; os with granulate membrane. Apocolpi perforate. Figure 3A, B. Table 2.

This species differs from *P. globosum* in having this year's growth branches straight rather than flexuous and 1–2 mm thicker in diameter than in *P. globosum*; leaflets 2–4 × 0.8–2 mm, mostly twice the length and width of those in *P. globosum*; a pubescent calyx green toward the teeth, not brown toward the apex as in *P. globosum*; a corolla white in the basal third and green elsewhere, with petals cucullate, not straight and incurved at the apex as occur in *P. globosum*, and pilose in the distal half

←

showing ventral suture. Original drawings from *R. A. Palacios et al. 2550* (BAFC, holotype). D–G, *P. angusticarpum* R. A. Palacios & Hoc. —D. Flower. —E. Leaf. —F. Stipules, with connate glands at base, and intermediate petiolar gland. —G. Fruit, seen from above and lateral view showing ventral suture. Original drawings for E, F, G from *Hoc et al. 371* (BAFC, paratype) and for D from *R. A. Palacios et al. 1803* (BAFC, paratype). A, B, D, E, F, scale bar = 1 mm. C, G, scale bar = 1 mm.

Table 2. Distinguishing pollen features of Argentinean *Prosopidastrum* species.

Character	*P. gracile*	*P. globosum*	*P. dehiscens*	*P. angusticarpum*
Apocolpi	Verrucate with pits	Verrucate or nonexistent	Perforate and/or perfossulate	Perforate and/or perfossulate
Colpi membrane	Verrucate, with granular and verrucate borders	Smooth, with verrucate and granulate borders	Granulate, with granulate and irregular borders	Smooth or scarcely granulate, borders smooth
Sculpture of apocolpi	Verrucate with pits	Verrucate or nonexistent	Perforate	Perforate and/or perfossulate
Sculpture of exine	Perforate with pits 0.24 μm diam., surrounded by few pits <0.1 μm diam.	Verrucate, perforate, with pits 0.47 μm diam. and perfossulate with fossulae 1.52 μm long	Perforate, with pits 0.88 μm diam., surrounded by scarce pits 0.3 μm diam.	Perfossulate, with fossulae 1.2 μm long and perforate with pits 0.6 μm diam.
Amb	Circular	Semiangular	Circular	Semiangular
Apertures	Grains 3-colporate	Grains 3–colporate or 3- to 4-syncolporate	Spherical	Oblate

abaxially; an ovary hirsute and green, not sericeous and red as in *P. globosum*; a fruit dehiscent by ventral sutures, with umbos contiguous along the generally connate crest, not a loment as seen in *P. globosum* (Table 1).

Distribution. Rocky soils of the sub-Andean mountains, between 1400 and 2200 m (Prov. of San Juan and Mendoza). In two localities the populations of *P. dehiscens* grow with others of *P. globosum* (Fig. 4), but we observed that hybridization does not occur and the individuals can be assigned to one species or the other.

Paratypes. ARGENTINA. **San Juan:** Depto. Calingasta, Ruta Provincial 141 de Tocota a Villanueva, ca. 7 km al N de Villanueva, Jan. 1997, *R. A. Palacios et al. 2771* (BAFC). **Mendoza:** Depto. San Carlos, La Jaula, 27 Nov. 1977, *R. Cordo & T. Ferrer* 77. d. 50 (SI); La Faja, 10 Nov. 1942, *A. Burkart et al. 14143* (SI); Depto. San Rafael, Sierra Pintada, camino a la cuesta del Agua de Los Terneros, 22 Dec. 1960, *A. Ruiz Leal 2572* (SI); San Rafael entre Malalhue y Chihuido, 1400–1480 m s. m., 27 Jan. 1941, *A. Ruiz Leal 7399* (SI); entre Cuesta de los Terneros y Ayo. Pavón, *H. A. L. 1463* (BA).

2. Prosopidastrum angusticarpum R. A. Palacios & Hoc, sp. nov. TYPE: Argentina. La Pampa: Loventué, entre El Durazno y Carro Quemado, 14 Feb. 1993, *P. S. Hoc, R. A. Palacios & M. A. Agulló 369* (holotype, BAFC; isotypes, MO, SI). Figure 1D–G.

Haec species a *P. globoso* (Gillies ex Hooker f. & Arnott) Burkart ramis hornotinis pungentibus, divaricatis non flexuosis, stipulis persistentibus spinosis, recurvis, foliolis papyraceis, floribus non sessilibus, pedicellis 0.5–2 mm longis, calyce membranaceo, glabro, petalis membranaceis, glabris, apice recurvo atque lomento patente piloso umbonibus a sutura visis cristis lobulatis differt.

Shrubs 1.2–1.5 m high. Hornotinous branches rigid, prickly, straight to recurved, spreading at 60–90° to the axis, divaricate, 2–3 mm diam. at base, puberulous in the furrows. Stipules 1–2.5 mm long, persistent, divergent, recurved, puberulous, with connate subhemispherical glandular bases. Leaves puberulous; petiole 0.5–2 mm long; pinnae 2–4 pairs, 3–10.5 mm long; leaflets 1–5 × 0.5–2 mm, papyraceous, oblong-elliptic. Capitulae 15–20 mm diam., with ca. 16 flowers; peduncle 7–15 mm long, puberulous, trichomes adpressed; bracts rhombic to ovate, cucullate, hirsute abaxially. Pedicel 0.5–2 mm long, puberulous; calyx yellowish white, 1–1.5 mm long, cupular, glabrous, membranous, with triangular teeth; corolla yellowish white, 3–4 mm long, glabrous, membranous, petals straight with recurved apex bearing glandular papillae; androecium (5)6–7 mm long, ca. twice as long as petals, filaments white, anthers yellow and oblong, ovary with adpressed pubescence. Loment, 3–7 per inflorescence, (36)40–75 × 3–4.5 mm, spreading, with straight or slightly sinuous margins, pilose, grayish brown, opaque; joints 9–18 per loment, 3.5–6 mm long × 3–5 mm wide, reticulately nerved; umbo with crests lobulated and trapezoidal or semicircular as seen from the suture. Pollen grains 3-colporate, oblate, amb semiangular. Exine perfossulate (fossulae 1.2 μm long.) and perforate (pits 0.6 μm diam.). Colpi membrane smooth or scarcely granulate, borders smooth; os with granulate membrane. Apocolpi perforate and/or perfossulate. Figure 3C, D. Table 2.

This species differs from *P. globosum* in having branches that are divaricate and prickly (vs. flex-

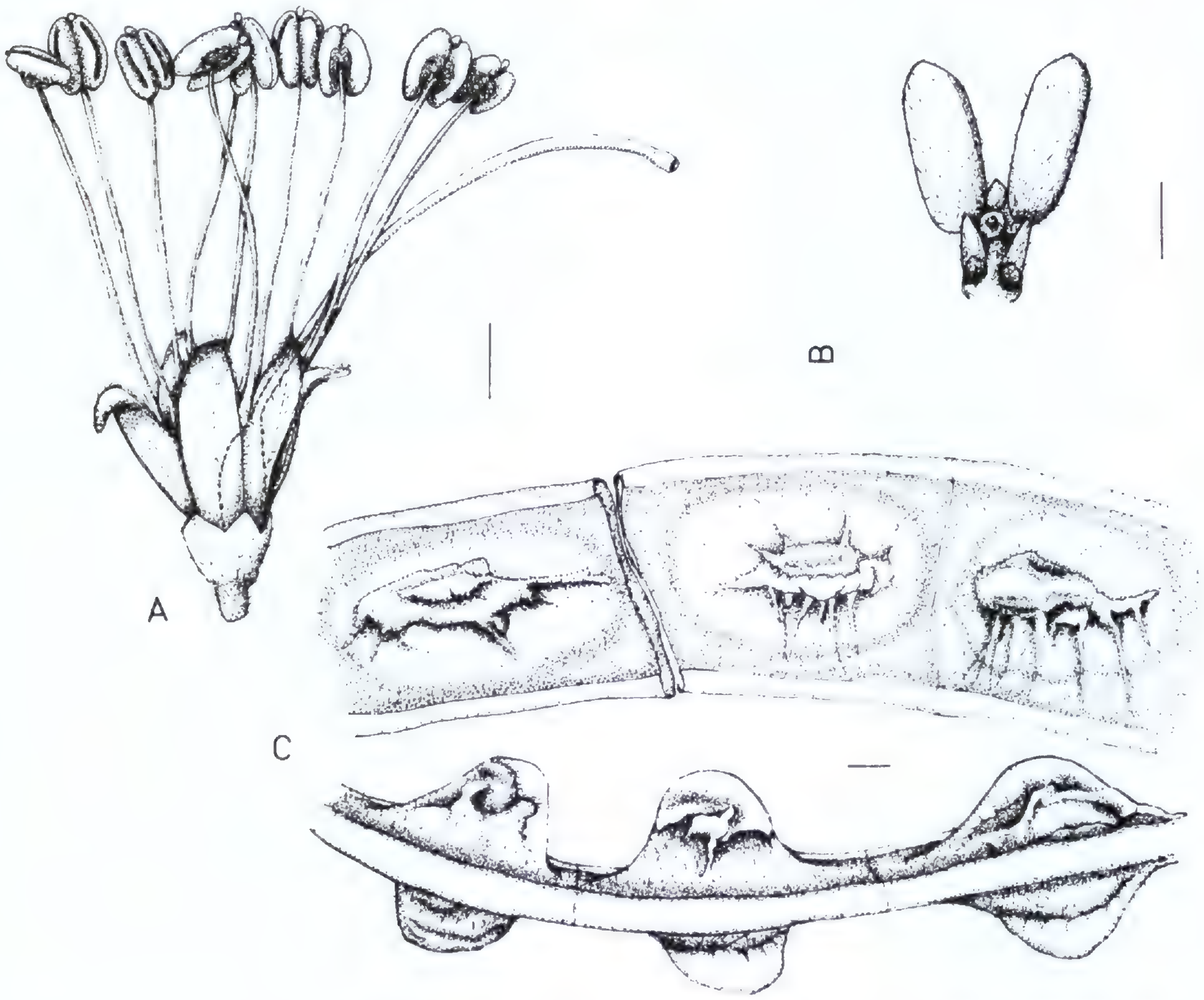


Figure 2. *P. gracile* R. A. Palacios & Hoc. —A. Flower. —B. Leaf, at the base, stipules straight, adpressed with their persistent glandular bases. —C. Fruit, seen from above and lateral view showing ventral suture. Original drawings from *P. S. Hoc 368* (BAFC, holotype). A, B, scale bar = 1 mm; C, scale bar = 1 mm.

uose as in *P. globosum*); stipules that are persistent, spinose and with connate glandular bases (vs. stipules that are not spinose and the glands that are not connate in *P. globosum*); leaflets that are papyraceous (vs. thick and pubescent as in *P. globosum*); flowers with pedicels 0.5–2 mm long, never sessile as in *P. globosum*; a calyx and corolla that are yellowish white, membranaceous and glabrous (vs. brown toward the apex and thickened as in *P. globosum*); petals with recurved apex (vs. incurved as in *P. globosum*); an androecium approximately twice the length of the corolla (vs. scarcely exceeding its length as in *P. globosum*); a pubescent green ovary (vs. red, sericeous as in *P. globosum*); a spreading, pilose loment that is grayish brown, and umbos with lobulate crests (vs. lomentum pendulous, chestnut-colored, with pubescence not adpressed, and umbos without crests in *P. globosum*) (Table 1).

Distribution. Thin, stony soils with calcareous outcrop (La Pampa and northern Río Negro; Fig. 4).

Paratypes. ARGENTINA. **San Luis:** Depto. La Capital, Estancia San Martín del Alto Negro, ca. del casco, 19 Dec. 1968, *Anderson et al. s.n.* (I.N.T.A. Va. Mercedes 684, SI); Gobernador Dupuy, entre Anchorena y Nueva Galia, 18 Jan. 1951, *A. Ragonese & B. Piccinini 7568* (BAB). **La Pampa:** Depto. Loventué, al sur de Victorica, 14 Jan. 1951, *R. Pérez Moreau & T. Perrone s.n.* (BA 30/097); entre El Durazno y Carro Quemado, 14 Feb. 1993, *P. S. Hoc et al. 371* (BAFC); Depto. Lihué Calel, Sierra de Lihué Calel, 30 Nov. 1959, *N. Troncoso et al. 20607* (SI), 7 Nov. 1972, *Del Puerto & Marchesi 11799* (SI), 24 Nov. 1941, *A. Castellanos s.n.* (BA 37/492), 21 Dec. 1947, *A. Krapovickas 3618* (BAB); Depto. Utracán, General Acha, 10 Jan. 1944, *A. T. Hunziker 4158* (SI); Estancia "Las Acacias", entre Acha y Chachaunanardi, 15 Feb. 1958, *F. Vervoorst 5880* (BAB). **Prov. Rio Negro:** Depto. General Roca, Paso Córdoba, 7 Nov. 1972, *E. M. Zardini & R. Kiesling 84* (SI); Depto. Pichi Mahuida, Ruta n° 251, entre Rio Colorado y Gral, Conesa, entre km 60 y 70, 25 Jan. 1990, *R. A. Palacios et al. 1803* (BAFC).

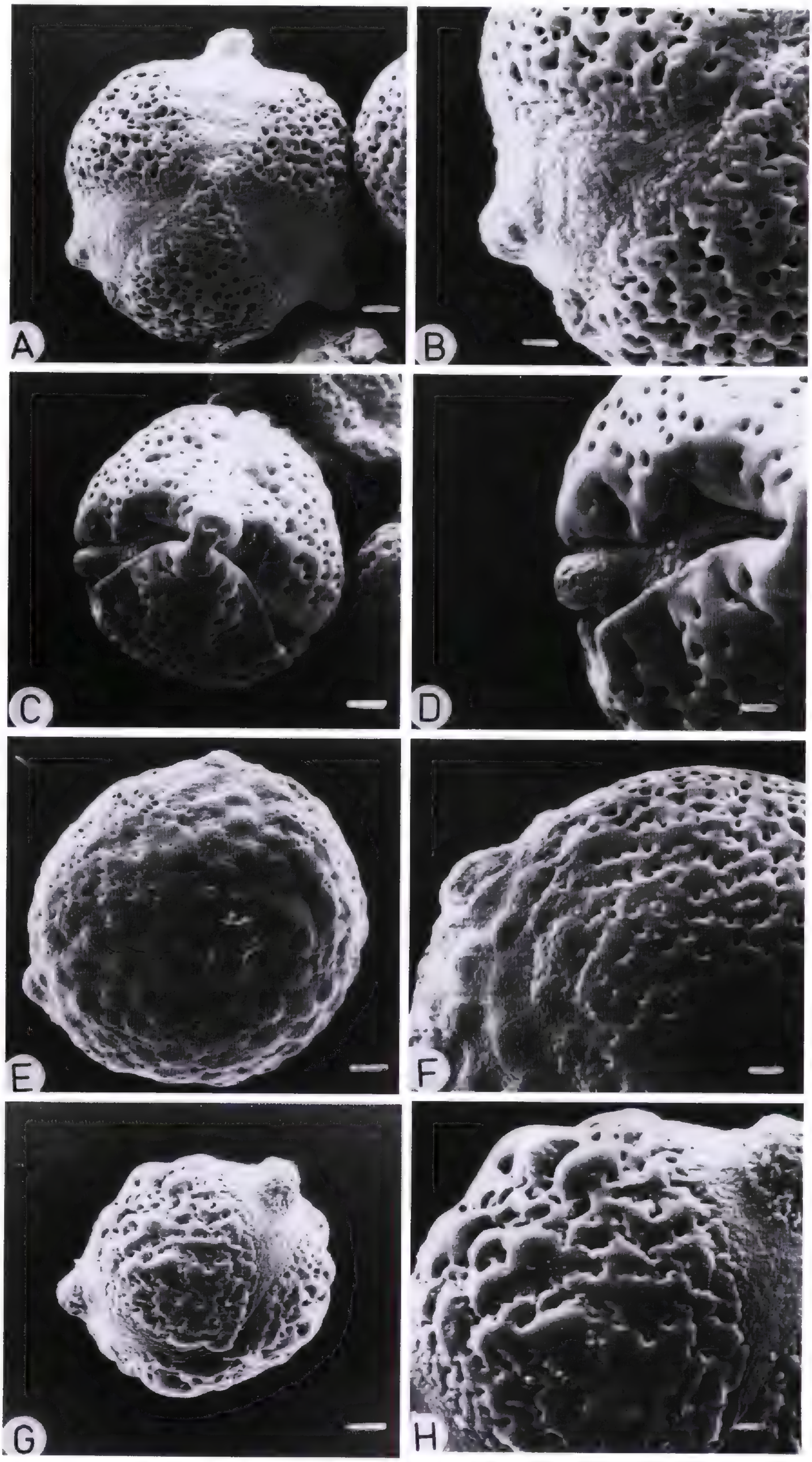


Figure 3. Pollen morphology. *P. dehiscens*:—A. Polar view (bar = 5 μm). —B. Colpus, os membrane and tectum sculpture (bar = 2 μm). *P. angusticarpum*:—C. Polar view (bar = 5 μm). —D. Colpus, os membrane, tectum sculpture

3. Prosopidastrum gracile R. A. Palacios & Hoc, sp. nov. TYPE: Argentina. Mendoza: General Lavalle, 5 km al sur del límite con San Juan, 13 Feb. 1993, *R. A. Palacios, P. S. Hoc & M. A. Agulló in P. S. Hoc 368* (holotype, BAFC; isotypes, MO, SI). Figure 2.

Haec species a *P. globoso* (Gillies ex Hooker f. & Arnott) Burkart ramis hornotinis fastigiatis, gracilibus, non flexuosis, stipulis non pungentibus, rectis adpressis, basi auriculatis, glandula ovato-triangulari persistente praeditis, pinnis 1-foliolatis, capitula 17–20 mm diam., floribus non sessilibus, pedicellis 0.1–0.5 mm longis, calyce membranaceo, puberulo, petalis membranceis rectis apice recurvis dorso puberulis marginibus in tertia parte apicali papillis glandulosis ornatis, atque lomento (35)90–210 × 5–8 mm stramineo, pubescentia villosa adpressa vestito differt.

Shrubs 1.5–2 m high; hornotinous branches fastigiate, slender, not prickly, 1–2 mm diam. at base, spreading at 15–50° to the axis, puberulous in furrows. Stipules 1–2 mm long, straight, adpressed, pubescent, auriculate, with a persistent ovate-triangular gland at the base. Leaves pubescent; petiole 0.5–1 mm long, gland stipitate, ovate to circular; pinnae 1-foliolate; leaflets 1–3 × 0.5–1 mm, elliptic to oblong, thickened, obtuse at apex. Capitulae 17–20 mm diam., with 13 to 26 flowers; peduncle 10–13 mm long, pubescent; bracts ovate-rhombic, hirsute-villose abaxially; pedicels 0.12–0.5 mm long. Calyx creamy white, 1.5 mm long, membranous, cupular, puberulous with triangular teeth; corolla creamy white, 3–4 mm long, membranous, petals straight with recurved apex, puberulous abaxially, with marginal glandular papillae on apical third; androecium 6–10 mm long, more than twice the length of petals, filaments white, anthers yellow, elliptical; ovary adpressed pubescent. Loments 1 to 7 per head, (35)90–210 × 5–8 mm, pendulous, straw-colored, straight to slightly arcuate, with margins straight to slightly sinuous, with adpressed villous pubescence; joints (2)11 to 19 per loment, 7–10 × 5–8 mm, umbos with triangular crests, trapezoidal or semielliptical as viewed from suture. Pollen grains 3-colporate, oblate, amb circular. Exine perforate, with pits 0.24 μm diam., surrounded by a few pits < 0.1 μm diam. Colpi membrane verrucate, borders granular and verrucate; os with annulus, membrane granulate. Apocolpi verrucate and with pits. Figure 3E, F. Table 2.

This species differs from *P. globosum* in having branches that are fastigiate, slender, not flexuose; stipules that are not spinose, but adpressed and auriculate at the base with ovate-triangular glands (vs. stipules spinose, divergent, and straight to recurved at the base with hemispherical-shaped glands in *P. globosum*); pinnae always 1-foliolate (vs. 1–3 paired); capitulae 17–20 mm diam. (vs. 8–15 mm diam. in *P. globosum*); pedicels 0.1–0.5 mm long (vs. flowers sessile in *P. globosum*); calyx and corolla creamy white, membranous, puberulous abaxially (vs. calyx white and brown toward the apex and thickened, the corolla green toward the margins and thickened in *P. globosum*); petals recurved at apex with glandular papillae along the distal third margin (vs. petals incurved at the apex and with glandular papillae only at the apex in *P. globosum*); stamens more than twice the length of the petals (vs. stamens scarcely exceeding the length of the corolla in *P. globosum*); an ovary that is pubescent and green (not red and sericeous as in *P. globosum*); loments straw-colored, with adpressed villous pubescence, segments 7–10 × 5–8 mm and umbos with crests (vs. loments chestnut-brown, with spreading pubescence, segments 4–5 × 3–4 mm and umbos without crests in *P. globosum*) (Table 1).

Distribution. Endemic to the sand dunes in the northeastern Province of Mendoza (Fig. 4).

Paratypes. ARGENTINA. **Mendoza:** Depto. Lavalle, Ruta 142, km 55 camino a Encón, 23 Nov. 1997, *P. S. Hoc 366, 367* (BAFC); 14 km al norte de El Alpero, 21 Jan. 1985, *J. H. Hunziker et al. 11254* (SI); Médanos, 1938, *Telechea s.n.* (BA 31/494).

Prosopidastrum globosum (Gillies ex Hooker f. & Arnott) Burkart, Darwiniana 13(2–4): 439. 1964. *Prosopidastrum globosa* Gillies ex Hooker f. & Arnott, Bot. Misc. 3: 205. 1832 (1833). *Mimosa globosa* (Gillies ex Hooker f. & Arnott) F. Macbride, Contr. Gray Herb. 59: 13. 1919. TYPE: "a low shrub rather sparingly in Valley of Uspallata," 31 Jan. 1825, leg. *Gillies* (lectotype, designated by Burkart (1964), SI ex K photo).

For full synonymy of this species, see Burkart (1945).

Shrubs 0.5–1 m high, hornotinous branches rigid, flexuose, 1–3 mm diam. at base, not prickly,

←

(bar = 2 μm). *P. gracile*:—E. Polar view (bar = 5 μm). —F. Colpus, os membrane, tectum sculpture (bar = 2 μm). *P. globosum*:—G. Polar-equatorial view (bar = 5 μm). —H. Colpus, os membrane, tectum sculpture (bar = 2 μm). Photographs taken from the exsiccatae: *R. A. Palacios et al. 2550* (BAFC); *Hoc et al. 369* (BAFC, holotype); *Hoc 368* (BAFC, holotype); *R. A. Palacios et al. 3034* (BAFC).

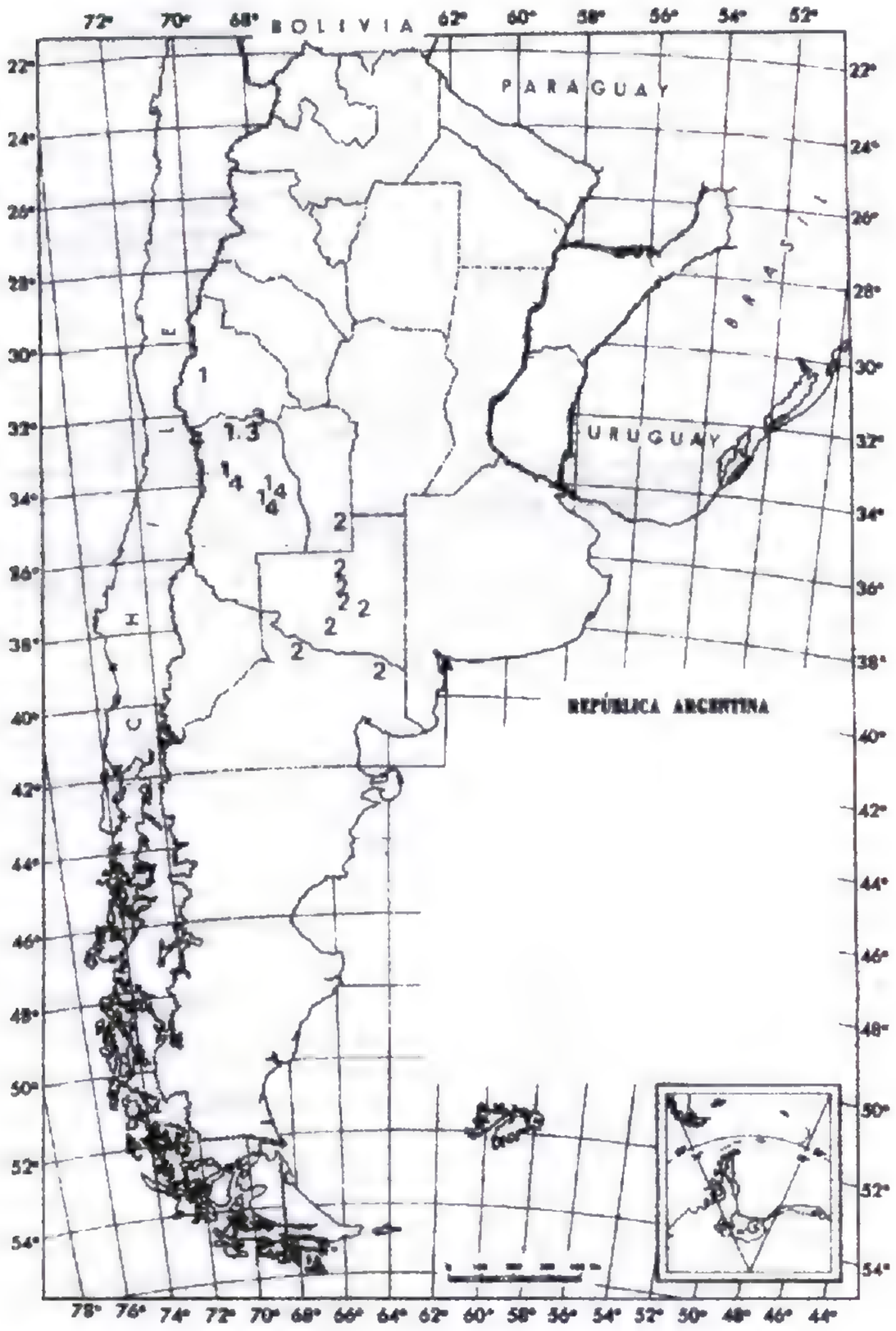


Figure 4. Distribution of the *Prosopidastrum* species endemic to Argentina: 1. *P. dehiscens*, 2. *P. angusticarpum*, 3. *P. gracile*, 4. *P. globosum*.

spreading at 45–70° to the axis, pubescence not adpressed. Stipules 1–2 mm long, spinose, straight to recurved, divergent, pubescent, with persistent hemispherical glandular base. Leaves pubescent; petiole 0.2–2 mm long; gland circular and sessile; pinnae 1-foliolate or containing up to 3 pairs of leaflets and 0–2 mm long; leaflets 0.5–2 × 0.5–1 mm, thick, elliptic. Capitulae with 23 to 27 flowers, 8–15 mm diam.; peduncle 5–13 mm long, pubescent; bracts spatulate to lanceolate, cucullate, hirsute abaxially. Flowers sessile. Calyx 0.5–2 mm long, white, brown toward apex, thickened, cupuliform to tubular, hirsute; corolla 3–4 mm long, petals white, green toward the margins and thickened, straight, incurved at apex, pilose abaxially in distal half, with glandular papillae at apex; androecium 3.5–6 mm long, filaments white, anthers elliptic, connective green; ovary red, sericeous. Loments 1 to 4 per infructescence, 60–70 × 3–4 mm, pendulous, with straight margins, spreading pubescence, chestnut-brown, opaque; joints 14 to 15 per loment, 4–5 × 3–4 mm, with semicircular umbo as seen from suture. Pollen grains 3-colporate or 3–4-syncolporate, spherical to oblate, amb semiangular. Exine verrucate, perforate (pits 0.47 μm diam.) and perfossulate (fossulae 1.52 μm long.). Colpi membrane smooth, borders verrucate and granulate; os membrane granulate. Apocolpi verrucate or nonexistent (grains syncolporate). (Fig. 3G, H; Table 2.)

Distribution. Sub-Andean mountains and their first slopes (Province Mendoza) (Fig. 4).

Paratype. "Loma de los Jagüeles, Province of Mendoza, leg. *Gillies*" (SI ex K photo).

Specimens examined. ARGENTINA. **Mendoza:** Depto. Uspallata, Uspallata, Km 1160, 20 Nov. 1996, *R. A. Palacios et al. 3033, 3034* (BAFC); Depto. San Rafael, Atuel Valley, El Sosneado, 6 Dec. 1955, *T. W. Böcher, P. Hjertinng & K. Rahn 1393* (SI); Depto. Malargüe, Malargüe, 11 Feb. 1942, *A. Burkart et al. 14147* (SI); Pampa del Alamo, 13 Jan. 1941, *A. Castellanos s.n.* (BA 36/729); Depto. Luján, Cerro Cacheuta, 11 Nov. 1949, *A. Ruiz Leal 12743* (SI).

KEY TO SPECIES OF *PROSOPIDASTRUM* (MEXICO AND ARGENTINA)

1a. Fruit 45–80 × 12–13 mm, dehiscing by two valves, these separating from a persistent replum and dividing into 1-seeded segments, sometimes functional; leaflets 4–8 × 2–4 mm; peduncles 22–35 mm long; Mexico, Baja California . . . . . *P. mexicanum*

1b. Fruit 40–210 × 3–8 mm, indehiscent loment or dehiscent by the ventral suture; leaflets 0.5–5 × 0.5–2 mm; peduncles 7–15 mm long; Argentina.

2a. Flowers pedicellate; calyx membranous, glabrous; petals membranous, glabrous, recurved at the apex; stamens (5)6–10 mm long; fruit always indehiscent; stipules persistent or not; leaflets papyraceous or thickened.

3a. Young branches divaricate, rigid, prickly; stipules persistent, recurved, prickly; glandular base persistent, glands connate; pinnae 2- to 4-foliolate, leaflets papyraceous; fruit 40–75 × 3–5 mm, spreading, grayish brown, pilose; thin, stony soils with calcareous outcroppings; La Pampa, north of Río Negro . . . . . *P. angusticarpum*

3b. Young branches fastigiate, gracile, not prickly; stipules deciduous, straight, adpressed, not prickly; base persistent, auriculate, with ovate-triangular glands; pinnae 1-foliolate, leaflets thickened; fruit 90–210 × 5–8 mm, pendulous, straw-colored, with adpressed pubescence and villous hairs; sand dunes of northeastern Mendoza . . . . . *P. gracile*

2b. Flowers sessile; calyx thick, pubescent or hirsute; petals thick, pilose; stamens 3.5–6.5 mm long; fruit dehiscent or not; stipules always deciduous; leaflets always thickened, 1-foliolate or with up to 3 pairs per pinna.

4a. Young branches flexuose; stipules straight, adpressed; calyx hirsute, petals

incurved; fruit 60–70 × 3–4 mm, indehiscent, pendulous; sub-Andean mountains and lower slopes of Mendoza (160–1100 m s. m.) . . . . . *P. globosum*

4b. Young branches rigid; stipules recurved or straight, not adpressed; calyx pubescent, petals cucullate; fruit 40–70 × (4)5–8 mm, dehiscent along ventral suture, spreading; sub-Andean mountains of San Juan and Mendoza (1400–2200 m s. m.) . . . . . *P. dehiscens*

Key to *Prosopidastrum* Native to Argentina on the Basis of Pollen Morphology

1a. Apocolpi verrucate with pits, verrucate or nonexistent.

2a. Colpi membrane verrucate, borders granular and verrucate; apocolpi verrucate with pits; exine perforate with pits 0.24 μm diam., surrounded by few pits < 0.1 μm diam.; amb circular; grains 3-colporate . . . *P. gracile*

2b. Colpi membrane smooth, borders verrucate and granulate; apocolpi verrucate or nonexistent; exine verrucate, perforate, with pits 0.47 μm diam. and perfossulate, with fossulae 1.52 μm long.; amb semiangular; grains 3-colporate or 3- to 4-syncolporate . . . . . *P. globosum*

1b. Apocolpi perforate and/or perfossulate.

3a. Colpi membrane granulate with granulate borders, irregular; apocolpi perforate; exine perforate with pits 0.88 μm diam., surrounded by few pits 0.3 μm diam.; amb circular; grains spherical . . . . . *P. dehiscens*

3b. Colpi membrane smooth or scarcely granulate, with smooth borders; apocolpi perforate and/or perfossulate; exine perfossulate, with fossulae 1.2 μm long. and perforate with pits 0.6 μm diam.; amb semiangular; grains oblate . . . . . *P. angusticarpum*

Acknowledgments. We thank J. Saunders for her English translation; E. Ulibarri for his kindness during our observation of herbarium specimens and phototypes; curators of the following herbaria where we examined specimens of *Prosopidastrum*: BAB, CA, GH, MEXU, MO, NY, SI, TEX-LL, and US; and CONICET and UBA for partially funding this work.

Literature Cited

Burkart, A. 1945. La intrincada sinonimia del "manca-caballo", *Prosopis globosa* Gill. Physis (Buenos Aires) 20: 53–54.

———. 1964. Leguminosas nuevas o críticas, VI. Darwiniana 13(3–4): 428–448.

A New Species of *Anthurium* (Araceae) from Chiapas, Mexico

Miguel Angel Pérez-Farrera
Escuela de Biologia, Universidad de Ciencias y Artes del Estado de Chiapas, A.P. 782, Tuxtla Gutierrez, Chiapas, 29000 Mexico

Thomas B. Croat
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. *Anthurium faustomirandae* sp. nov. is described and illustrated from Chiapas, Mexico. It is similar to *A. titanium* Standley & Steyermark but differs from that species in having persistent intact cataphylls, thicker pruinose leaf blades with an acute rather than acuminate apex, and a shorter, stouter inflorescence with a much broader spathe and more stipitate spadix.

RESUMEN. *Anthurium faustomirandae* sp. nov. de Chiapas es descrita e ilustrada. Presenta afinidad con *A. titanium* Standley & Steyermark de Chiapas, pero difiere de esta especie en la catafila intacta persistente, lamina pruinosa con apice acuminado, inflorescencia con una espata mucha mas ancha y espadice más estipitado.

Key words: *Anthurium*, Araceae, Mexico.

During a trip to San Fernando, Chiapas, Mexico, for a monitoring project of cycad populations, we collected an *Anthurium* with a large leaf very similar in size to that of *A. titanium*. The new collection was distinct from that species, especially by its short inflorescences, intact cataphylls, and pruinose blades. The new species has been confused with *A. titanium*, a species endemic to a small area of southeastern Chiapas in Mexico and adjacent western Guatemala in the Department of San Marcos at elevations of 900 to 1800 m.

Anthurium faustomirandae Pérez-Farrera & Croat, sp. nov. TYPE: Mexico. Chiapas: Montañas del Norte, 2 km N of Colonia Cuactemoc, Mpio. de San Fernando, 850 m, 16 Apr. 1995, *Pérez-Farrera 263* (holotype, CHIP; isotype, MO).

Planta rupestris; caudex ad 18–23 cm longus, 7.6–8.7 cm diam.; petiolus 82–109 cm longus; lamina ovata, coriacea, basi cordata, 73–89 cm longa, 48–62 cm lata. Inflorescentia petiolis breviora; pedunculus 9.2–24 cm longus, 5.3–13.2 mm diam., erectus; spatha coriacea, oblongo-lanceolata, 14–29 cm longa, 4.6–10.6 cm lata, spadice viridi, 12–17 cm longa, 1.4–2 cm diam. Baccae virides.

Rupicolous plant; stems short, light brown, generally 18–23 cm long; sap pale yellow to light green; internodes short, 7.6–8.7 cm diam., leaf scars 4–7 cm wide. Roots ± thick, 5.5–6.8 mm diam., pale gray-brown, descending; cataphylls persistent, 14–27 cm long, moderately coriaceous fresh, papyraceous on drying, pale olive-green fresh, drying medium to light yellow-brown, acute at apex, persistent intact at apex but sometimes splitting as red-brown fibers at base. *Leaves* ± pendent from erect-spreading petioles; *petioles* subterete, obtusely flattened adaxially, sometimes weakly D-shaped, medium green, semiglossy, sometimes yellowish to light cream short-lineate throughout, 82–109 cm long, 11.4–12.8 mm diam., 1.6 cm diam. midway; geniculum 4.5–6.6 cm long, to 2 cm diam. at apex, ± D-shaped; *blades* deeply cordate, ovate to broadly ovate or nearly rounded, 73–89 (–130) cm long, 48–62(–135) cm wide, ca. 1.4–1.5 times longer than wide, broadest at middle or just below, moderately coriaceous, epunctate, semiglossy, dark green above, moderately paler and pruinose below, gradually acuminate at apex (sometimes apiculate with acumen 1–2 mm long); margins markedly undulate; anterior lobe 51–65.5 cm long with margins broadly rounded; posterior lobes 18–32 cm long; sinus spathulate, acute to rounded at apex; midrib convex and slightly paler above, convex and slightly paler, sometimes more acute below; basal veins 6–9 pairs, the first and often second free to base, the 3rd–4th and higher veins coalesced 4.5–7.5 cm, raised above and below; posterior ribs conspicuously upturned along margin, naked for 2.5–6 cm; primary lateral veins 3–4 per side, departing midrib at 40°–45° angle, ± straight to collective vein; interprimary veins usually not apparent except near apex; lesser veins distinct, weakly raised below; collective veins arising from the first basal vein on smaller blades or from one of the primary lateral veins on the larger blades, weakly sunken above, raised below, 8–10 mm from margin, loop-connecting to primary lateral

Figure 1. *Anthurium faustomirandae* Pérez-Farrera & Croat. —Top left. Leaf blades in face view (*Pérez-Farrera 263*). —Top right. Stem showing cataphylls (*Selby 1996–0174*). —Bottom left. Inflorescence showing erect spathe (*Selby 1996–0174*). —Bottom right. Infructescence showing immature berries (*Pérez-Farrera 263*).

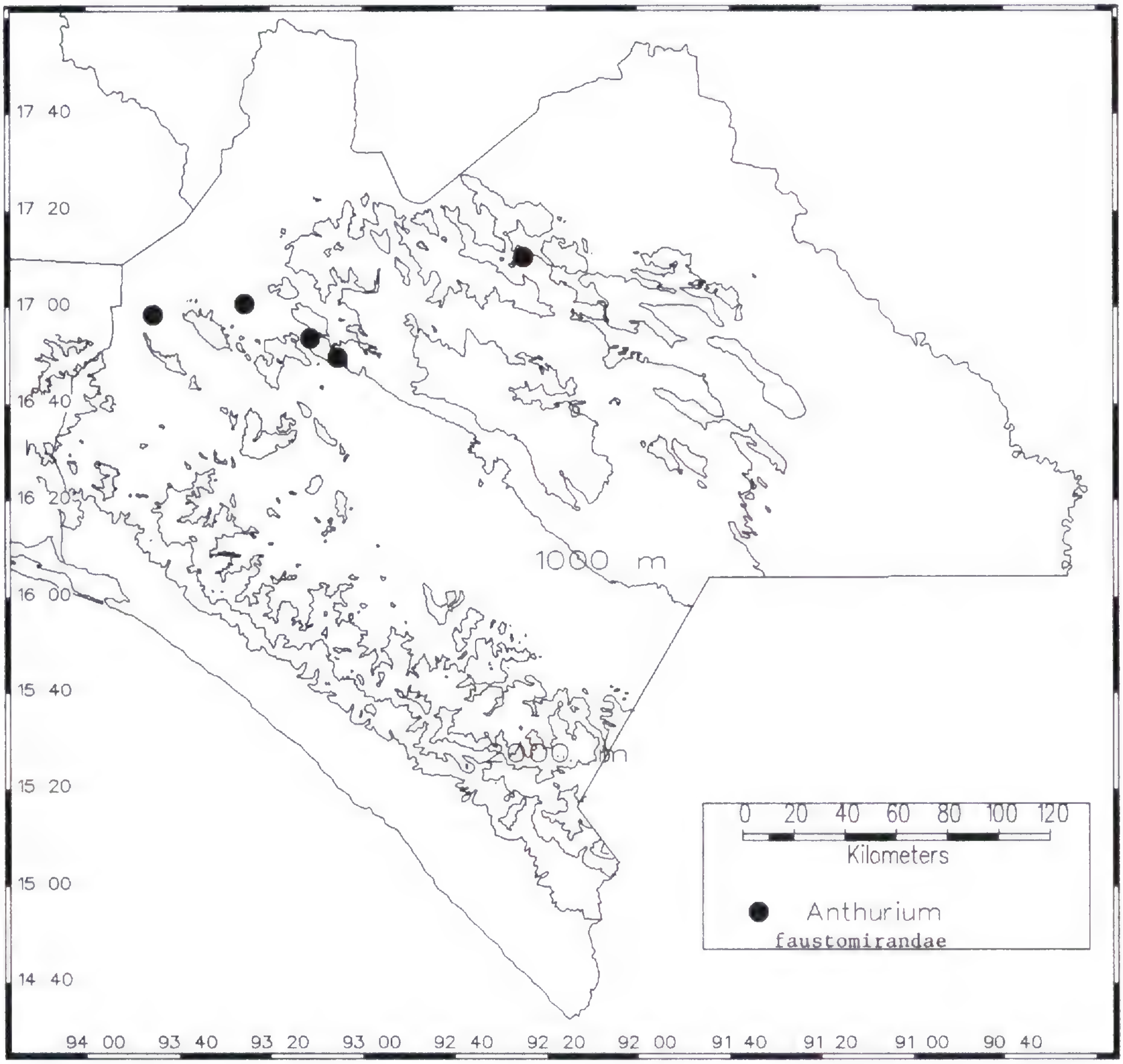


Figure 2. Map of Chiapas State, México, showing distribution.

veins. *Inflorescence* erect-spreading, much shorter than petioles; peduncle 9.2–24 cm long, 5.3–13.2 mm diam., terete; spathe hooding spadix, coriaceous, light green within, medium green outside, broadly lanceolate, 14.2–29 cm long, 4.6–10.6 cm wide, broadest just above base, long-acuminate, cirrhose and inrolled at apex, inserted at 40° angle on peduncle; shortly stipitate for 3–6 mm long in front, 1–2 mm long in back; spadix spindle-shaped, olive- to light green, 12–17 cm long, 1.4–2 cm diam. at base, 0.7–1.3 cm diam. at apex; flowers 4-lobed, 2–3 mm long, 2–3.5 mm wide, margins sinuate to weakly sigmoid. *Infructescence* arching-pendent; spathe usually persisting; spadix green, to 20 cm long, to 3 cm diam.; berries olive-green, obovoid to ellipsoid, rostrate at apex, mesocarp pulpy, light yellow-cream; seeds 2 per berry, dark cream to light yellow, ovate-ellipsoid, 2 cm long, 0.7 cm wide (Fig. 1).

DIAGNOSTIC KEY

1a. Blade not pruinose, subcoriaceous; the surface quilted (raised between the primary lateral veins); cataphylls weathering to coarse fibers; inflorescence usually moderately slender with the peduncle usually longer than spadix; spathe 1.8–3.2 cm wide; spadix stipitate 4.5–7 mm long in back . . . . . *A. titanium*

1b. Blade often pruinose, moderately coriaceous; the surface scarcely or not at all quilted; cataphylls persisting ± intact; inflorescences usually moderately stout with peduncle usually shorter than spadix; spathe 4.6–10.6 cm wide; spadix stipitate 1–2 mm long in back . . . . *A. faustomirandae*

Habitat

Anthurium faustomirandae is apparently endemic to the state of Chiapas in Mexico, occurring at 850–1000 m elevation. It is known for certain only from a small area of northeastern Chiapas in an area of "Bosque Tropical Perennifolio" in the mountains between Yajalon and Tila, where it occurs on karst rocks (Fig. 2), and near San Fernando (Ocozocoautla, Cintalapa), near the northern limits of the Central Depression of Chiapas in areas of "Bosque Tropical Subcaducifolio" (Rzedowski, 1978). In the latter area it occurs with an overstory of *Belotia mexicana* (DC.) Schumann, *Ficus* sp., *Manilkara chicle* (Pittier) Pennington, *M. zapota* (L.) P. Royen, *Sideroxylon* sp., *Bursera simaruba* (L.) Sargent, *Ficus hemsleyana* Standley, *Playmiscium dimorphandrum* D. Smith, a shrubby layer dominated by *Astrocaryum mexicanum* Liebmann, *Chamaedorea ernesti-angusti* H. Wendland, *C. glaucifolia* H. Wendland, *C. arenbergiana* H. Wendland, *Heliconia* sp., and a herbaceous layer comprised of *Anthurium huixtlense* Matuda, *A. clarinervium* Matuda, *A. pentaphyllum* (Aublet) G. Don var. *bombacifolium* (Schott) Madison, and a *Calathea* sp.

Discussion

The species is tentatively placed in *Anthurium* sect. *Calomystrium* owing to its persistent intact cataphylls, subterete petioles, and thick spathe and spadix. Mexican species have proven to be unique, isolated, and distinct from other species in the same sections in other parts of Central America. Breeding studies should be carried out between *A. faustomirandae* and *A. huixtlense* Matuda, a species of unquestioned placement in section *Calomystrium*, to confirm its placement here. The species was first collected by botanist Faustino Miranda at San Fernando, Chiapas, based on *Miranda 6160* and *6162* (Miranda, 1952). Miranda determined it as *A. xanthosomifolium* Matuda (perhaps due to its large leaves), which is now a synonym of *A. titanium* (Croat, 1983). Miranda's original live collection of this species is still in cultivation in the Jardín Botánico "Faustino Miranda" at the Instituto de Historia Natural in Chiapas. The new species is by far the largest *Anthurium* in Mexico, attaining a size even larger than that of *A. titanium*. *Anthurium faustomirandae* is easily the largest species in Mexico and Middle America.

The species is named in honor of the late Spanish botanist Faustino Miranda (1905–1964) who lived and worked in Mexico. He was the first to collect the species and to bring it into cultivation. It is a very desirable cultivar and has been in cultivation for many years by a number of people in the Miami, Florida, area.

Paratypes. MEXICO. **Chiapas:** 8 km W of Petalcingo, Tila, *Pérez-Farrera 1655A* (CHIP); 21 km N of Tuxtla Gutierrez, Mirador La Atalaya, Cañon del Sumidero, *Pérez-Farrera 1706G* (CHIP); El Encajonado, Selva El Ocote, Cintalapa, *Pérez-Farrera 1867A* (CHIP); 15 km N of Ocozocoautla-Cosoleacaque, Ocozocoautla, *Pérez-Farrera 1886* (CHIP); Montañas del Norte, 2 km N of Colonia Cuactemoc, Municipio de San Fernando, *Miranda 6160* (MEXU), *6162* (CHIP).

Acknowledgments. We thank Francisco Hernandez Najarro for help with fieldwork and measurements, as well as Maria A. Velazquez Martinez, Jesus De la Cruz Rodriguez, and Oscar Farrera Sarmiento for processing of plants from Instituto de Historia Natural and Escuela de Biología de la Universidad de Ciencias y Artes del Estado de Chiapas. We also thank Dewey Fisk (Davie, Florida) and Jay Vaninni (Guatemala) for providing details of live plants of both species.

Literature Cited

Croat, T. B. 1983. A revision of the genus *Anthurium* (Araceae) of Mexico and Central America. Part 1: Mexico and Middle America. Ann. Missouri Bot. Gard. 70: 211–420.

Miranda, F. 1952. La Vegetación de Chiapas. Vol. 1. Gobierno del Estado de Chiapas, Tuxtla Gutierrez.

Rzedowski, J. 1978. La Vegetación de México. Edit. Limusa, México, D.F.

A New Species of *Podostemum* (Podostemaceae) from the States of Paraná and Santa Catarina, Brazil

C. Thomas Philbrick

Department of Biological and Environmental Sciences, Western Connecticut State University, Danbury, Connecticut 06810, U.S.A.

Alejandro Novelo R.

Departamento de Botánica, Instituto de Biología, Universidad Nacional Autónoma de México, México, D.F., 04510, México

ABSTRACT. A new species of Podostemaceae, *Podostemum irgangii*, from the states of Santa Catarina and Paraná, Brazil, is described and illustrated. Features that distinguish the new species are the uniformly verticillate leaves and two forms of stipules. Adjacent to either side of the leaf base, adnate to the stem, occur two lobed or unlobed, stiffened ear-shaped stipules that are 0.7–1.1 mm wide and project 0.4–0.6 mm from the stem. Three to nine finger-like upright stipules, 0.3–0.5 mm long, occur on the adaxial side of the petiole base.

RESUMO. Descreve-se e ilustra-se uma nova espécie de Podostemaceae, *Podostemum irgangii* dos Estados de Santa Catarina e Paraná, Brasil. Estruturas qualitativas que distinguem a nova espécie correspondem a folhas e estípulas. As folhas com folíolos verticilados (5–14 verticilos por folha, 6–11 folíolos por verticilo) são únicos em *Podostemum*. Duas formas de estruturas estipulares estão associadas a cada folha. Adjacentes a cada lado da base da folha, adnatas ao caule, ocorrem estípulas rígidas auriculares, bilobadas ou inteiras, com 0.7–1.1 mm de largura, projetando-se a 0.4–0.6 mm do caule. Além disso, 3–9 estruturas estipulares retas, digitiformes, encontram-se na face adaxial da base do pecíolo.

Key words: Brazil, Podostemaceae, *Podostemum*.

Podostemum was established by A. Michaux (1803) when he described the largely temperate species *Podostemum ceratophyllum* Michaux. Van Royen (1954) conducted a taxonomic treatment of the New World genus and recognized 17 species, distributed primarily in southern South America. Although two species in India and Ceylon (*P. subulatus* Gardner, *P. barberi* Willis) were once placed in *Podostemum*, they are now recognized as belonging to the genus *Zeylanidium* (*Z. subulatus* (Gardner) C. Cusset, *Z. barberi* (Willis) C. Cusset) (Cook, 1996; Cusset, 1992).

Van Royen's treatments (1951, 1953, 1954) are of fundamental importance in understanding the taxonomy of the family Podostemaceae in the New World. Yet the taxonomy of many genera remains chaotic. *Podostemum* is one such genus, where boundaries between many species are based on minute quantitative and subtle qualitative features of leaves, including the sheathing base. Our ongoing studies, based on extensive field collections, reveal that several currently recognized species (e.g., *P. dentatum* P. Royen, *P. schenckii* Warming) represent environmental forms of more widespread species (e.g., *P. muelleri* Warming and *P. distichum* (Chamisso) Weddell, respectively) (Philbrick & Novelo, unpublished). Continuing studies are revealing that *Podostemum* is not as large a genus (17 species) as was proposed by Van Royen (1954). Nonetheless, while conducting field studies in the state of Santa Catarina, Brazil, several populations were discovered in which plants possessed features that were qualitatively different from all other species in *Podostemum*. These populations are herein described as a new species.

Podostemum irgangii Philbrick & Novelo, sp. nov. TYPE: Brazil. Santa Catarina: Abelardo Luz, "Quedas do rio Chapecó," a series of waterfalls located ca. 5 km W of the city of Abelardo Luz, common, submerged along edge of rapids in swift current, 26°33′3″S, 52°19′31″W, 670 m, 13 Jan. 1999, *Thomas Philbrick, Alejandro Novelo, Bruno Irgang & Claudio de Senna 5466A* (holotype, ICN; isotypes, MEXU, MO, NY, WCSU). Figure 1.

Planta aquatica perennis ad saxa in aquis fluentibus; folia disticha, caulis axe perpendicularia vel leviter reflexa, stipulata, segmentis stipularibus duabus formis valde dissimilibus: (1) duobus segmentis auriculiformibus

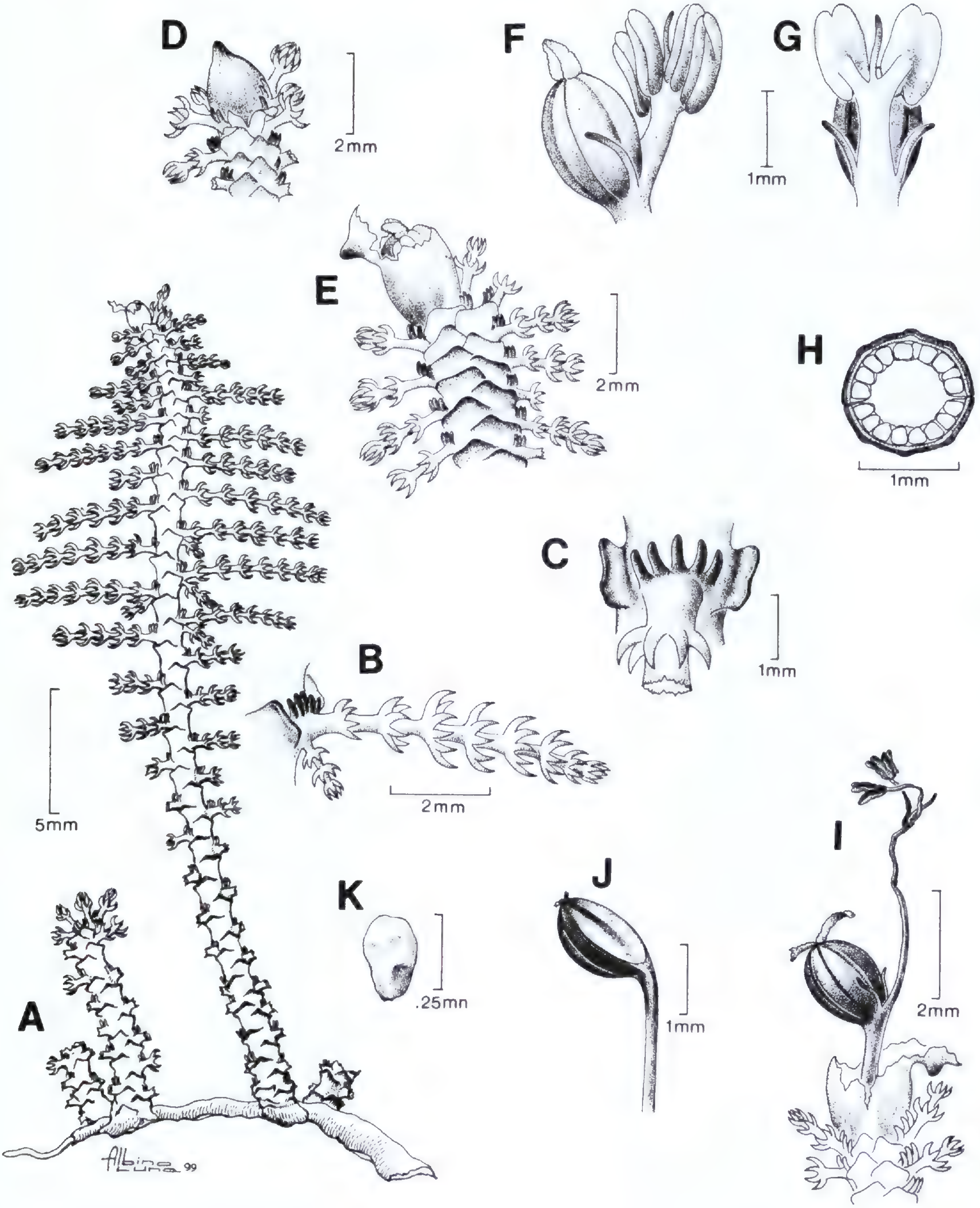


Figure 1. *Podostemum irgangii* Philbrick & Novelo. Drawings based on the holotype unless otherwise noted. —A. General habit of the plant; note stems arising from flattened, prostrate root. —B. Leaf attached to stem; note two types of stipules and rudimentary leaf division projecting down. —C. Node of stem showing leaf base, verticillate leaf segments, and two types of stipules. —D. Apex of stem with flower bud (intact spathella). —E. Apex of stem with flower bud (dehisced spathella); note reflexed cap-like apex of spathella. —F. Young flower prior to anther dehiscence showing lateral view of andropodium; note lateral and andropodial tepals (based on *Philbrick & Novelo 5455*). —G. Young flower prior to anther dehiscence showing face view of andropodium; note two lateral and one andropodial tepals (based on *Philbrick & Novelo 5455*). —H. Cross section of ovary showing placenta and numerous ovules. —I. Apex of stem with mature post-anthesal flower; note distinct ribs on maturing fruit. —J. Persistent valve of capsule (based on *Philbrick & Novelo 5449*). —K. Seed.

rigidis, lobatis vel non lobatis, utrinque basi petioli caulo adnatis, 0.7–1.1 mm latis, ab caulo 0.4–0.6 mm procurrentibus; (2) 3–9 structuris erectis, digitiformibus, latere adaxiali petioli, caulo adjacentibus, rigidis, 0.3–0.5 mm longis, obtusis; ambabus formis persistentibus folia decidunt postea, nigrescentibus. Folia ad 7 mm longa, axe centrali, quo verticillis foliolaribus exorientibus, 6–11 foliolis per verticillum, 5–14 verticillis per folium, distantia inter verticillos 0.3–0.6 mm, foliolis rotundato-triangularibus, 0.3–0.5 mm longis, incurvatis. Spathella apicaliter rumpens, parte apicali pileata reflectenti.

Aquatic herbs, perennial. Roots green, elongate, prostrate, flattened to elliptical in cross section, tightly attached to rocks via holdfasts (haptera) and adhesive hairs, 0.3–2.1 mm (mean, median = 0.9 mm; N = 100) wide, branched, growing intertwined. Stems arising opposite or alternate along the flanks of roots, 0.2–20 mm (mean = 5.3 mm, median = 4.2 mm; N = 50) apart, erect, 0.1–4.5 cm long (mean, median = 2.0 cm, N = 85), elliptical to terete in cross section at base, branched or unbranched, 0.6–2.2 mm (mean, median = 1.5; N = 50) diameter at base, narrower toward apex. Leaves distichous, arising perpendicular to the stem axis or slightly reflexed; petiolate, petiole 0.2–0.4 mm (mean, median = 0.3 mm; N = 50) long, elliptical in cross section; stipulate; stipules of two different forms: (1) two ear-shaped, lobed or unlobed stiff stipules detached from the leaf base on either side of the petiole base, perpendicular to the stem axis or at an angle of up to 45° relative to the stem axis, 0.7–1.1 mm (mean, median = 1 mm; N = 50) wide, projecting 0.4–0.6 mm (mean, median = 0.5 mm; N = 50) from stem; (2) 3 to 9 (mean, median = 5; N = 50) upright, finger-like stipules traversing the adaxial side of the petiole adjacent to the stem, rigid, 0.3–0.5 mm (mean, median = 0.4 mm; N = 50) long, blunt; both types of stipules persisting after the leaves have fallen away, becoming blackened. Leaves 3–7 mm (mean, median = 5 mm; N = 50) long, with a central axis from which arise verticillate scales, 6 to 11 (mode, median = 9; N = 50) scales per verticil, 5 to 14 (mode, median = 8; N = 50) verticils per leaf, 0.3–0.6 mm (mean, median = 0.5 mm; N = 50) between verticils; scales rounded-triangular, 0.3–0.5 mm (mean, median = 0.6 mm; N = 50) long, incurved. Flowers hermaphroditic, zygomorphic, pedicellate, borne singly in a leaf axil, usually near the stem apex, covered by a spathella. Spathella clavate, minutely papillate, 2.3–5.6 mm (mean = 3.3 mm, median = 3.0 mm; N = 50) × 1.1–2.1 mm (mean, median = 1.4 mm; N = 50), rupturing apically, the cap-like apical portion becoming reflexed. Pedicels 1.0–5.0 mm long (mean, median = 1.6 mm; N = 55). Tepals 3, scale-like, linear, acute, one on either side of the andropodium, the third arising from the fork between the two stamen filaments, lateral tepals 0.6–1.9 mm (mean, median = 1.1 mm; N = 63) long, median tepal 0.4–1.1 mm (mean, median = 1.0 mm; N = 50) long. Stamens 2, deciduous, borne on an andropodium; andropodium elongating during anthesis, 0.3–4.6 mm (mean = 1.6 mm, median = 1.1 mm; N = 50) long. Filaments elongating at anthesis, 0.3–1.7 mm (mean = 0.7 mm, median = 0.5 mm; N = 50) long. Anthers quadrangular, tapering toward the base, 0.8–2.1 mm (mean, median = 1.4 mm; N = 50) × 0.7–1.3 mm (mean, median = 0.8 mm; N = 50), dehiscing introrsely or latrorsely, inner thecae shorter than outer ones. Pollen in dyads, tricolpate, 32–40 μm (mean, median = 36 μm; N = 50) × 20–25 μm (mean, median = 23 μm; N = 50). Ovary 2-locular, oriented obliquely on the pedicel, with 2 unequal carpels, 0.6–2.1 mm (mean, median = 1.4 mm; N = 60) × 0.8–1.6 mm (mean = 1.5 mm, median = 1.1 mm; N = 60), with 6 longitudinal dark lines on the ovary wall. Stigmas 2, free, conical when young, elongating after anthesis, 0.4–1.6 mm (mean = 0.8 mm, median = 0.7 mm; N = 50) long. Fruit a 2-locular capsule, 1.2–2.1 mm (mean, median = 1.6 mm; N = 50) × 0.9–1.7 mm (mean = 1.3 mm, median = 1.2 mm; N = 50), with two unequal valves, one valve caducous, the other persistent; valves 3-ribbed, suture margins appearing thickened and rib-like. Seeds numerous, 0.25–0.33 mm (mean, median = 0.29 mm; N = 50) × 0.15–0.23 mm (mean = 0.19 mm, median = 0.18 mm; N = 50), outer integument becoming expanded and sticky when wetted. Attached to rocks in swiftly moving river current.

Podostemum irgangii is known from south-central Paraná and north-central Santa Catarina, Brazil (Fig. 2). *Podostemum irgangii* is named in honor of Bruno E. Irgang (ICN), whose assistance has been invaluable in our studies of South American Podostemaceae.

Additional observations. Features of the sheathing leaf base and overall leaf form are fundamental in the taxonomy of *Podostemum* (Van Royen, 1954). In most species of *Podostemum* the sheathing leaf base is cymbiform (boat-shaped) and amplexicaul. An extension of the apical portion of the sheath ("intrapetiolar stipule" of Van Royen, 1954: 229; referred to as a stipule here) can be entire and hood-like, or cut into two to several tooth-like segments. Stipules can be flexible or stiffened, and in some species they persist after the leaf has fallen away as hardened structures lateral to the persistent petiole base. Leaf form varies from simple to

Figure 2. Known distribution of *Podostemum irgangii* in southern Brazil. Solid circles denote collections by the authors. Solid squares denote collections by others. The single diamond is a location from which collections by both the authors and other collectors were made.

many times divided, e.g., dichotomous, subdichotomous, irregular. Moreover, leaf divisions can be arranged either two-dimensionally, with flattened divisions oriented in the same plane as the previous division; or three-dimensionally, with flattened divisions oriented perpendicular to that of the previous division. *Podostemum irgangii* differs qualitatively in the form of stipules from other species of *Podostemum*. The two forms of stipules (see below) that are found in *P. irgangii* do not occur in any other species.

Podostemum irgangii is morphologically most similar to *P. distichum*, a widespread and morphologically variable species of southern Brazil, Argentina, and Uruguay. The two species, however, can readily be distinguished by their stipules and often leaves. *Podostemum distichum* has one type of stipule, with two to four flexible to rigid triangular segments. In contrast, *P. irgangii* has two markedly different types of stipules (Fig. 1B, C): (1) two ear-shaped stipules adnate to the stem on either side of the leaf base, and (2) 3 to 9 upright, finger-like stipules arranged in a row on the adaxial side of the petiole base adjacent to the stem. Both of these stipular structures are firm when young, become more hardened and black several nodes below the stem apex, and typically persist after the leaves have fallen away. *Podostemum distichum* and *P. irgangii* thus can be readily distinguished with actively growing or senesced vegetative specimens based on stipule form.

Both *P. distichum* and *P. irgangii* have divided leaves. Leaves of *Podostemum distichum* are highly variable in form; the segments can be irregularly arranged, subdichotomous, dichotomous, semi-verticillate (a central rachis from which irregularly placed ultimate divisions arise), or (rarely) verticillate. When semi-verticillate or verticillate, there are two or three primary axes on the leaf. In contrast, leaves of *P. irgangii* have a single primary axis and are uniformly verticillate; they are composed of a central rachis from which arise whorls of ultimate leaf divisions (Fig. 1A, B). A rudimentary secondary axis sometimes occurs on the abaxial side of the petiole base (Fig. 1B). Leaves of *P. irgangii* and the semi-verticillate or verticillate leaf forms of *P. distichum* can be confused. In such instances, however, examination of the stipules provides a ready means of distinguishing the two species.

It is evident that *P. irgangii* was first collected in the 1950s, although not recognized as distinct. Collections in several herbaria (B, HBR, L, NY, US) are clearly *P. irgangii*. In addition, several collections of *P. irgangii* (see below) are listed as *P. distichum* by Van Royen and Reitz (1971) in their treatment of Podostemaceae for *Flora Ilustrada Catarinense*. Moreover, one of the two collections of *P. irgangii* from the state of Paraná (*Smith, Klein & Hatschbach 15714*, US) is a mixed collection of *P. distichum* and *P. irgangii*.

The authors collected *P. irgangii* from two rivers in north-central Santa Catarina: Chapecó River and Chapecozinho River. Both rivers are ca. 150–200 m wide and flow over largely horizontal basaltic outcrops. In these rivers *Podostemum irgangii* grew in open, sunny areas in swift current. The two locations in the Chapecó River are east of the city of Abelardo Luz. At one location (*Philbrick, Novelo, Irgang & de Senna 5455–5459*) *P. irgangii* was common and grew intermixed with *P. distichum*. Other Podostemaceae (*Podostemum rutifolium*, *Mourera aspera* (Bongard) Tulasne, and *Tristicha trifaria* (Bory ex Willdenow) Sprengel) were also common associates. The second location in the Chapecó River (*Philbrick, Novelo, Irgang & de Senna 5466, 5472*) is along a series of waterfalls (known locally as "Quedas do Rio Chapecó") that span several kilometers of the river. Here, too, *P. irgangii* and *P. distichum* both occurred. The podostemads *Podostemum muelleri* and *Mourera aspera* were common at this location. *Podostemum irgangii* was uncommon in the Chapecozinho River (*Philbrick, Novelo, Irgang & de Senna 5449*) in the town of Xanxeré, below a large waterfall known locally as "Cascata Manela." At this location only exposed senescent plants were collected. Other podostemads at this location were *Tristicha trifaria*, *Apinagia* sp., *Podostemum distichum*, and *Podostemum rutifolium*.

Paratypes (* denotes specimens cited by Van Royen & Reitz (1971) as *Podostemum distichum*). BRAZIL. **Paraná:** 20 km N of Iratim, General Carneiro, *Smith, Klein & Hatschbach 15714* (US) [mixed with *Podostemum distichum*]; Mun. Laranjeiras do Sul, rio Canta Galo, 26 Apr. 1968, *Hatschbach 19182* (US). **Santa Catarina:** *Irani, Campo de Irani, ca. 26°57′S, 51°50′W, alt. 700–900 m, 15 Dec. 1964, *Smith & Klein 13992* (US); *2 km W of rio Capetinga on the road to Dionisio Cerqueira, 900–1000 m, *Smith, Reitz & Sufridini 9619* (HBR not seen, L, US); *rio Irani, 23 km E of Ponte Serrada, 600–800 m, *Smith & Reitz 9888* (HBR not seen, L, US); *rio Chapecó, Abelardo Luz, 26°35′S, 52°20′W, 900 m, *Smith & Klein 13892* (B, HBR not seen, NY); rio Chapecó, "Quedas do rio Chapecó," a series of waterfalls ca. 5 km W of the city of Abelardo Luz, 26°33′17″S, 52°19′32″W, 670 m, *Philbrick, Novelo, Irgang & de Senna 5472* (ICN, MEXU, WCSU); rio Chapecozinho, waterfall called "Cascata Manela," Xanxeré, ca. 75 m downstream from waterfall, 26°45′48″S, 52°28′03″W, 620 m, *Philbrick, Novelo, Irgang & de Senna 5449, 5450* (ICN, MEXU, WCSU); rio Chapecó, ca. 10–15 km E of city of Abelardo Luz at a location called "Prainha," 26°34′49″S, 52°17′30″W, 740 m, *Philbrick, Novelo, Irgang & de Senna 5455–5459* (ICN, MEXU, WCSU).

Acknowledgments. We thank Léia Scheinvar for the Portuguese translation of the abstract, Fernando Chiang for the Latin description and his review of the manuscript, and Albino Luna for drawing Figure 1. Two anonymous reviewers provided valuable comments on an earlier version of this manuscript. Bruno E. Irgang and Claudio V. de Senna Gastal are thanked for all their assistance and encouragement while conducting field studies in southern Brazil. This work was supported by National Science Foundation Grants DEB-9496053 and DEB-9629767 to C.T.P. The following herbaria are thanked for providing loans of specimens: B, ICN, L, MEXU, NY, US, WCSU.

Literature Cited

Cook, C. D. K. 1996. Aquatic and Wetland Plants of India. Oxford Univ. Press, Oxford.

Cusset, C. 1992. Contribution à l'étude des Podostemaceae:12. Les genres asiatiques. Bull. Mus. Hist. Natl. Nat., Paris, 4ᵉ Sér., 14, Sect. B, Adansonia, 1: 13–54.

Michaux, A. 1803. Flora boreali-americana. 2.

Royen, P. Van. 1951. The Podostemaceae of the New World. Part I. Meded. Bot. Mus. Herb. Rijks. Univ. Utrecht 107: 1–151.

———. 1953. The Podostemaceae of the New World. II. Acta Bot. Neerl. 2: 1–20.

———. 1954. The Podostemaceae of the New World. III. Acta Bot. Neerl. 3: 215–263.

——— & P. R. Reitz. 1971. Podostemáceas: Familia da Flor-da-Cachoeira. Flora Ilustrada Catarinense 1ª (parte 5): 2–36.

Ianthopappus, a New Genus of the Tribe Mutisieae (Compositae)

N. Roque

Departamento de Ciências Biológicas, Laboratório de Taxonomia Vegetal, Universidade Estadual de Feira de Santana, Bahia, Brazil

D. J. N. Hind

The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom

ABSTRACT. The new genus *Ianthopappus* Roque & D. J. N. Hind (Compositae, Mutisieae) is described, and a new combination, *Ianthopappus corymbosus* (Lessing) Roque & D. J. N. Hind, is made. The single species is easily distinguished by its subshrubby habit, discolorous leaves with actinodromous venation, corymbiform inflorescences, and a 3-seriate pappus with ca. 130 free, purple setae. Comparison is made between *Ianthopappus* and other members of the Mutisieae that possess apiculate to acuminate apical anther appendages and are placed in a more narrowly defined subtribe Gochnatiinae. *Ianthopappus* is distributed in southern South America from Brazil (Rio Grande do Sul), Uruguay, and northern Argentina.

Key words: Argentina, Brazil, Compositae, *Ianthopappus*, Mutisieae, South America, Uruguay.

The generic position of *Gochnatia corymbosa* Lessing (Compositae, tribe Mutisieae Cassini) has been debated since its initial description (Lessing, 1830). Bentham (1873) considered that *G. corymbosa*, with its habit and distinctive capitulum, was better assigned to the genus *Onoseris* Willdenow. This position was maintained by Baker (1884), but later contested by Ferreyra (1944) in his revision of *Onoseris*. Ferreyra (1944), after having examined *Sellow 3479* (later the neotype of *Gochnatia corymbosa* assigned by Cabrera, 1970), concluded that the species was not an *Onoseris* but probably a species of *Gochnatia*, the genus in which it was initially described. Cabrera (1970) re-assessed the tentative generic position of this species and treated it as a species of *Actinoseris* (Endlicher) Cabrera, transferring it from *Gochnatia*, based principally on the heterogamous radiate capitulum.

According to Bremer (1994), *Gochnatia* is the crucial taxon in understanding the Mutisieae. In *Gochnatia*, which is the largest genus of the tribe, all species have discoid homogamous capitula and the apical anther appendages are acuminate to apiculate. Bremer (1994: 80) also stated that "a number of genera apparently have their sister groups within *Gochnatia*." The examples given were *Actinoseris*, *Chucoa* Cabrera, *Cnicothamnus* Grisebach, *Cyclolepis* Gillies ex D. Don, *Hyalis* D. Don ex Hooker & Arnott, and *Nouelia* Franchet. These are distinguished mainly by capitula characters and geographic distribution (Table 1).

In the present paper, it is proposed that *Actinoseris corymbosa* (Lessing) Cabrera is recognized as belonging to a new genus, based upon our extensive morphological studies. *Ianthopappus corymbosus* is characterized by its striate leafy, silvery stem, the truncate elliptic to orbicular leaves, which are discolorous, white-tomentose to glabrescent above, silvery-sericeous beneath and have actinodromous venation, the corymbiform inflorescences, and the 3-seriate pappus, with ca. 130 purple setae (Table 2).

The new genus is described below.

Ianthopappus Roque & D. J. N. Hind, gen. nov. TYPE: *Ianthopappus corymbosus* (Lessing) Roque & D. J. N. Hind. Figure 1.

Tribus Mutisieae, subtribus Mutisiinae Lessing. Suffrutex; caules omnino foliosi; folia e base valde 3-nervia; inflorescentia laxe corymbosa, pauciceps vel multiceps; capitula radiata, heterogama, pedicellata, pedicellis bracteolatis; involucrum 5–7 seriatum; flosculi purpurascentes, eis marginatis bilabiatis, feminina, eis centralibus profunde 5-lobatis etiam bisexualibus; rami stylorum bifidi, appendices antherarum basales caudatae, longe attenuatae, pilosae, apicales item longe attenuatae; achenia longe denseque setulifera; pappus 3-serialis, purpurascens, setis apice dilatatis.

Ianthopappus corymbosus (Lessing) Roque & D. J. N. Hind, comb. nov. Basionym: *Gochnatia corymbosa* Lessing, Linnaea 5: 263. 1830. *Onoseris corymbosa* (Lessing) Bentham & Hooker f., Gen. pl. 2(1): 487. 1873. *Actinoseris corymbosa* (Lessing) Cabrera, Bol. Soc. Argent. Bot. 13: 52. 1970. TYPE: Brazil. "*Sellow* in Brasilia meridionali (v.sp.s.∞)." Syntypes: B destroyed. *Sellow 3479* (neotype, designated by Cabrera (1970), K; isoneotype, P (designated here), photo FI, NY, US). [Following Herter & Rambo (1953), *Sellow 3479* was collected in January 1826 between São Gabriel and Ibicuí in the state of Rio Grande do Sul, Brazil.] Figure 1.

Table 1. Genera related to *Ianthoppapus corymbosus* with apiculate to acuminate apical anther appendages (following Bremer, 1994).

	Geographic distribution	Species number	Habit	Capitula	Florets
Actinoseris	Brazil	7	Subshrubs, herb	Scapose to cymose, radiate, heterogamous	Ray: white; disc: white or rose
Ianthopappus	Brazil, Uruguay, Argentina	1	Subshrub	Corymbose, radiate, heterogamous	Ray: white; disc: purple
Chucoa	Peru	1	Shrub; spiny leaves	Solitary, discoid, homogamous	Yellow
Cnicothamnus	Bolivia, Argentina	2	Shrubs or small trees; pinnately nerved leaves	Solitary, radiate homogamous	Orange-yellow to orange-red
Cyclolepis	Bolivia, Argentina, Paraguay	1	Gynodioecious shrub, halophytes	Solitary to sub-spiciform, discoid, homogamous	Yellowish
Gochnatia	Southern United States, West Indies, Central and South America, Asia	ca. 68	Trees, shrubs, rarely subshrubs; sometimes dioecious	Solitary to corymbose or paniculate, discoid, homogamous	Cream or yellowish
Hyalis	Bolivia, Argentina, Paraguay	2	Subshrubs; 3–5-nerved leaves	Corymbose, radiate, homogamous	Pink, white, or purple
Nouelia	China	1	Shrub	Solitary, radiate, homogamous	Ray and disc florets white

Subshrub to 1 m, chamaephyte, stems striate, leafy, silvery, glabrescent. Leaves alternate, sessile to subsessile, petiole to 8 mm, truncate, lamina coriaceous, elliptic to orbicular, 4.0–8.5 × 2.3–8.0 cm, discolorous, white-tomentose and glabrescent above, silvery-sericeous beneath, 3-veined, venation actinodromous, margins entire, apex obtuse, mucronulate. Inflorescence few- to many-headed (2–18), corymbiform-paniculate, peduncle sericeous when young, glabrescent, later becoming glaucous-green, bracteate; lower bracts foliose, 2.5–5.0 × 0.8–2.0 cm, elliptic; upper bracteoles ca. 3–5 mm long, lanceolate, sericeous, upper surface red wine-colored, lower surface silvery-green, apices erect to reflexed, acuminate. Capitula radiate, heterogamous; involucres campanulate, 2 cm diam. × 1.5 cm tall; phyllaries 5–7-seriate, apices erect to curved, acuminate, outermost 4–6 × 0.5 cm, lanceolate, innermost 1.0–1.2 × 0.5 cm, linear, sericeous, inner surface purple, outer surface sericeous, silvery-green. Florets ca. 46, corolla fleshy, corolla tube glabrous, corolla-lobe apices revolute, obtuse, fleshy on outer surface, papillose, rarely short-pubescent; ray florets female, bilabiate, ca. 10, white, outer surface of limb and lobes red-wine-colored, 1.4–1.8 cm long, staminodes 3–5 mm long; disc florets bisexual, 5-lobed, purple, 1.5 cm long, corolla lobes ca. 0.7 mm long; anther cylinder 6–7 mm long, purple, inserted halfway up the corolla tube; apical anther appendages acute to acuminate, basal anther appendages caudate, laciniate; style ca. 1 cm long with swollen base, glabrous, style-arms 2, sometimes 3, short, glabrous, purple. Cypselas fusiform, 10-ribbed, 13–15 mm long, setuliferous, silvery-green; embryo obovate, ca. 5 mm long; pappus setae 3-seriate, ca. 6 mm long, ca. 130, free, coarsely barbellate, purple.

Ianthopappus corymbosus has a southern extratropical distribution in the extreme south of Brazil, in the region of Alegrete and Uruguaiana (Rio Grande do Sul), and extends into Argentina (Corrientes) and Uruguay (Artigas) (Fig. 2).

Mondin and Baptista (1996: 67) indicated that the Brazilian region where the species is found in southwestern Rio Grande do Sul is called "campanha." According to the authors, the vegetation in this region is "campestre," with a predominance of

→

Figure 1. *Ianthopappus corymbosus* (Lessing) Roque & D. J. N. Hind (*Roque et al. 462*). —A. Habit. —B. Rootstock. —C. Involucre. —D. Inner phyllary. —E. Ray floret. —F. Disc floret. —G. Anther. —H. Style (apex and base). —I. Ribbed cypselas. —J. Cypselas opened along the ribs. —K. Seed in longitudinal section. —L. Embryo.

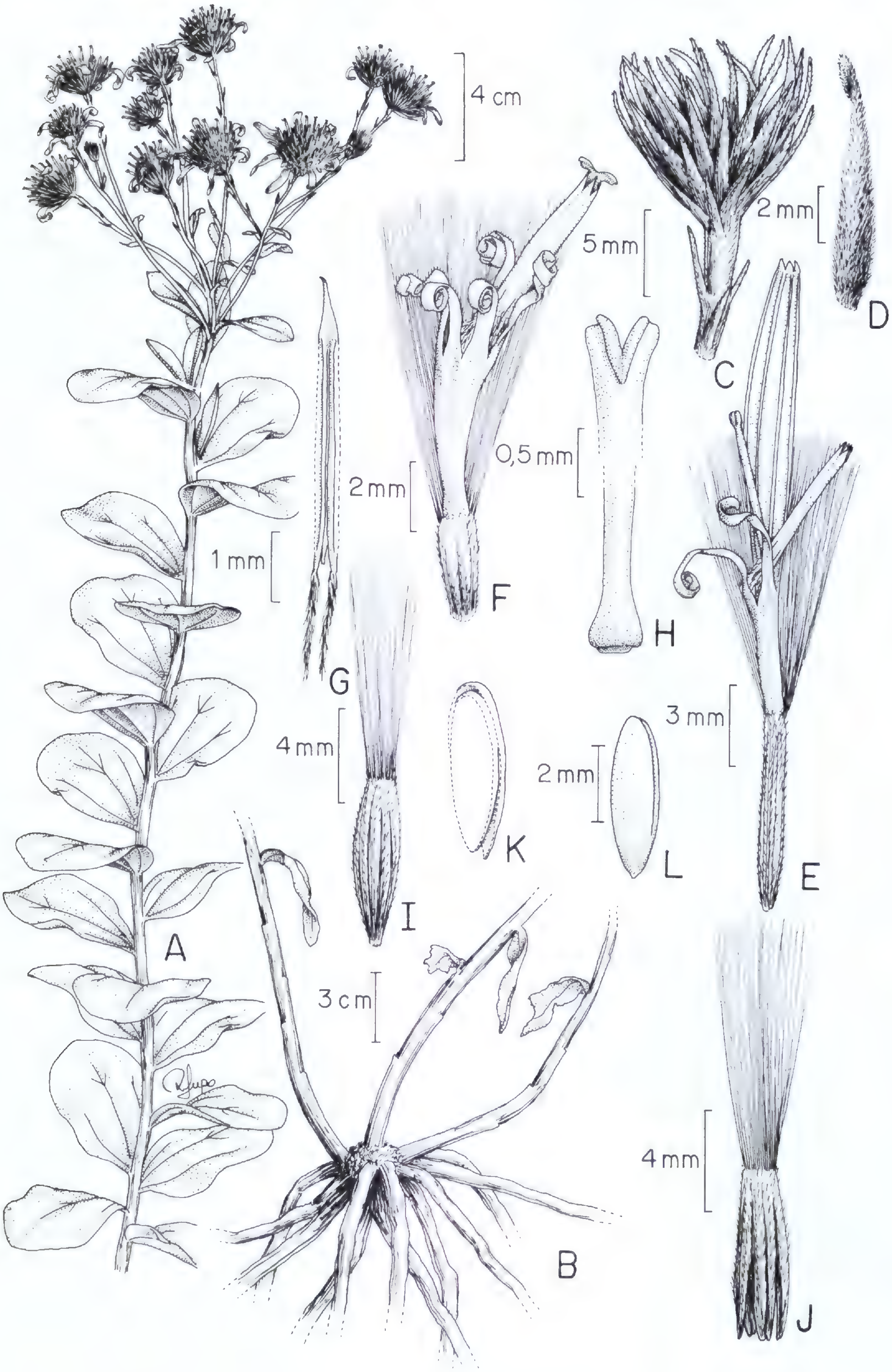

4 cm
5 mm
2 mm
D
C
2 mm
0,5 mm
F
H
G
3 mm
4 mm
2 mm
K
L
E
1 mm
I
A
3 cm
4 mm
B
J

Table 2. Comparison of *Ianthopappus* with *Gochnatia* and *Actinoseris* based on morphological studies.

	Ianthopappus	*Gochnatia* s.str.* (Cabrera, 1971)	*Gochnatia* sect. *Discoseris* (Cabrera, 1971)	*Actinoseris* (Cabrera, 1970)
Habit	Subshrub	Trees or shrubs**	Subshrubs***	Subshrubs or herbs
Leaf venation	Actinodromous	Actinodromous to pinnate	Pinnate	Pinnate
Pappus	3-seriate	2-seriate	1-seriate	1-seriate
Number of pappus setae	Ca. 130	Ca. 50	35–38	25–40
Pappus setae	Free	Free	United at base into fleshy ring	United at base into fleshy ring
Pappus coloration	Purplish	Straw	Straw	Straw

* *Gochnatia* Kunth excluding *Gochnatia* sect. *Discoseris* Cabrera.
** Woody stem and shoots.
*** Stem unbranched, woody only at the base.

steppe and several pockets of steppe-like savanna. Steppes represent a subtropical community demonstrating double extremes of seasonality, one season caused by the cold of the polar fronts in the winter and the other associated with a short period of drought during the summer. All of the species of the tribe Mutisieae occurring in the campestre vegetation (five species of *Chaptalia* Ventenat, three species of *Pamphalea* Lagasca, three species of *Trixis* P. Browne, *Gochnatia polymorpha* (Lessing) Cabrera subsp. *ceanothifolia* (Lessing) Cabrera, *Holocheilus brasiliensis* (L.) Cabrera, *Jungia floribunda* Lessing, *Mutisia coccinea* A. St.-Hilaire, *Perezia multiflora* Lessing, *Schlechtendalia luzulifolia* Lessing, and *Trichocline incana* Cassini), including *I. corymbosus*, are also present in Uruguay.

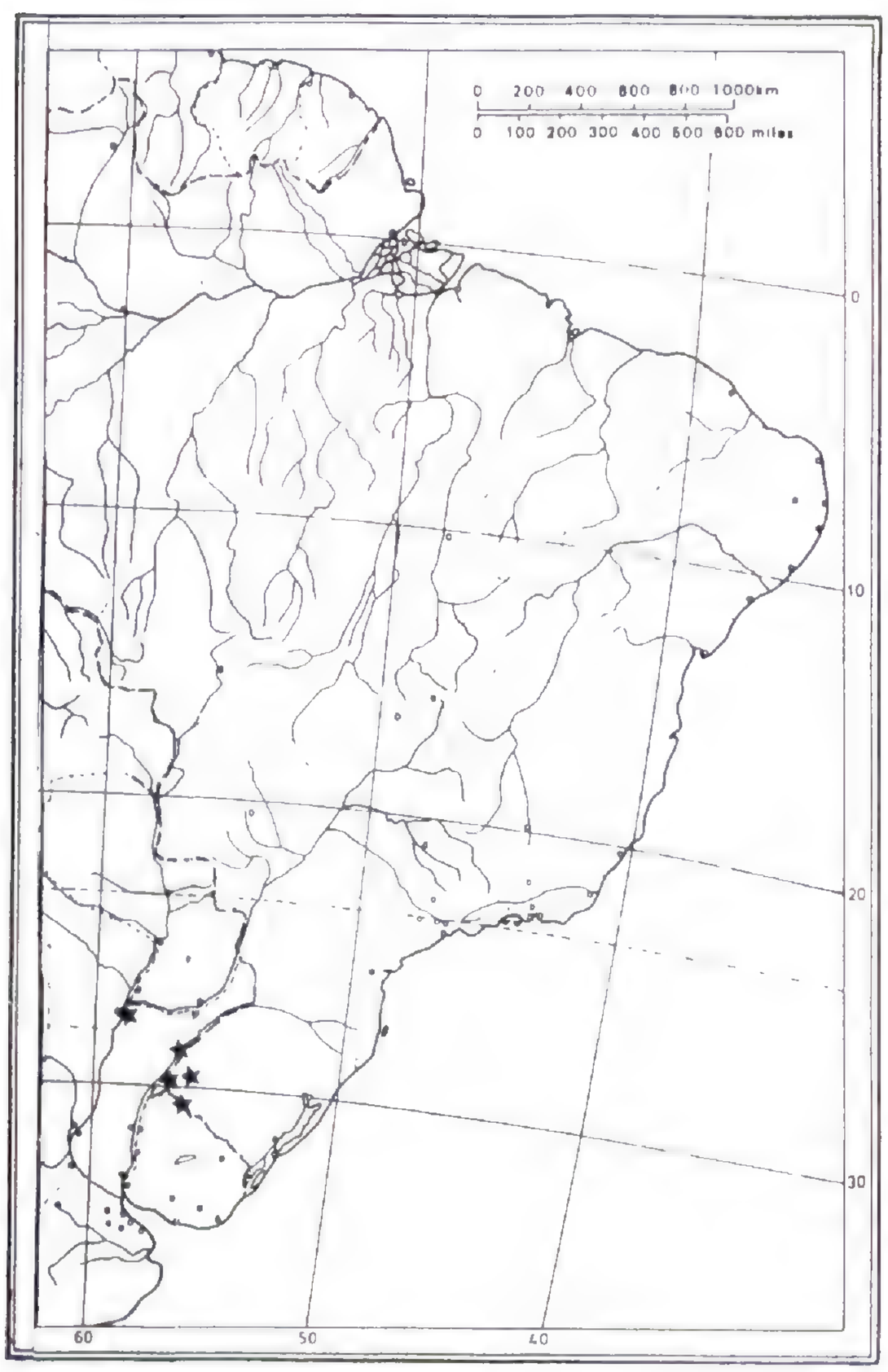


Figure 2. Geographic distribution of *Ianthopappus corymbosus* (★).

Ianthopappus corymbosus was recently collected by N. Roque (March 1998) in the Reserva Biológica de Ibirapuitã, Alegrete (Rio Grande do Sul, Brazil), from a small population with clumped individuals in "campo sujo" in sandy soil and marshes. This species stands out with its distinctive purplish pappus and red-wine-colored corolla contrasting with the silvery indumentum of the involucre and the underside of the leaves. It was noted that several aerial stems are produced from the same rootstock (Fig. 1B). No other members of the Mutisieae were found in the same locality.

The latter material has mature achenes apparently exhibiting precocious germination while still in the capitulum (Fig. 1J). The achene wall is often seen fractured, exposing the enclosed seed. This phenomenon has not been observed in other material of *Ianthopappus* or other members of the Mutisieae.

Material examined. ARGENTINA. **Corrientes:** 1831, *Bonpland s.n.* (P); Paso Troncón, 26 Mar. 1948, *Palacios-Cuezzo 2304* (LP). **Santo Tomé:** 27 Feb. 1983, *Schinini et al. 23425* (MBM); 10 km SE de Azara, 13 Feb. 1991, *Tressens et al. 3840* (MBM). BRAZIL. **Rio Grande do Sul:** Alegrete, Reserva de Ibirapuitã, 03 May 1986, *Wasum s.n.* (PACA 73215, UCS 1529, US); Reserva Biológica do Ibirapuitã, 21 Mar. 1998, *Roque et al. 462* (K, SPF); Uruguaiana, 19 Aug. 1957, *Spies s.n.* (PACA 60771); s. loc. Província do Rio Grande, 1833, *Sellow 831* (P); s. loc. spec. 1821, *St. Hilaire Cat. C2–2614* (P); 1821,

St. Hilaire 521 Cat. C2–2617 (P 2x). URUGUAY. **Artigas:** Rio Cuareim, 1836, *Chebataroff 3015* (LP).

Acknowledgments. The authors are grateful to the curators of the following herbaria for the loan of material: FI, LP, K, MBM, NY, P, PACA, UCS, US. Various aspects of the present study (undertaken by N. Roque) were supported by CAPES. Logistic support for the first author was provided by the Universidade de São Paulo during her Ph.D. studies. Special thanks are due to José Rubens Pirani (Universidade de São Paulo) for useful comments on this manuscript. Sincere acknowledgments are extended to Ronaldo Wasum (Universidade de Caxias do Sul) and Eliseu Moraes (Secretário do Meio Ambiente de Alegrete) for extending every hospitality to the first author in locating this plant in the field. The authors also thank Mike Lock (Royal Botanic Gardens, Kew) for providing the Latin diagnosis.

Literature Cited

Baker, J. G. 1884. Compositae. IV. Helianthoideae, Helenioideae, Anthemideae, Senecionidae, Cynaroideae, Ligulatae, Mutisiaceae. *In* C. P. von Martius & A. W. Eichler (editors), Flora brasiliensis 6(3): 339–396.

Bentham, G. 1873. *In* G. Bentham & J. D. Hooker (editors), Genera Plantarum 2(1): 487. Reeve, London.

Bremer, K. 1994. Asteraceae: Cladistics & Classification. Timber Press, Portland, Oregon.

Cabrera, A. L. 1970. *Actinoseris,* nuevo género de Compuestas. Bol. Soc. Argent. Bot. 13(1): 45–52.

———. 1971. Revisión del género *Gochnatia* (Compositae). Revista Mus. La Plata 12(66): 1–159.

Ferreyra, R. 1944. Revision del género *Onoseris* Willd. J. Arnold Arbor. 25: 349–395.

Herter, W. G. & B. Rambo. 1953. Nas pegadas dos naturalistas Sellow e Saint-Hilaire. Estudios Botanicos em la region Uruguaya. Revista Sudamer. Bot. 10(3): 61–98 & tab. 7.

Lessing, C. R. 1830. Synathereis Herbarii Regii Berolinensis, Dissertatio Tertia, Linnaea 5: 237–263.

Mondin, C. A. & L. R. M. Baptista. 1996. Relações Biogeográficas da tribo Mutisieae Cassini (Asteraceae), *sensu* Cabrera, no Rio Gande do Sul. Comum. Mus. Ciênc. Tecnol.- PUCRS, Sér. Bot. Porto Alegre 2: 4–152.

Two New Species of *Philodendron* (Araceae) from Brazil

Cássia M. Sakuragui

Departamento de Biologia, Centro de Ciências Biológicas, Universidade de Maringá, Av. Colombo 5790, 87020-900, Paraná, Brazil

ABSTRACT. Two new species of *Philodendron*, *P. simonianum* and *P. vargealtense*, are recognized from southeastern Brazil, both belonging to *Philodendron* sect. *Calostigma*.

Key words: Araceae, Brazil, *Philodendron*.

Philodendron, with more than 600 species, is the second largest genus in the Araceae. It is an exclusively neotropical genus occurring mostly in humid, tropical forests. During a revision of Brazilian species of *Philodendron* sect. *Calostigma* (Schott) Pfeiffer (Sakuragui, 1999), two new species from the Atlantic forest of southeastern Brazil were discovered; they are described herein.

The genus *Philodendron* was described by Schott (1829), and the first infrageneric revision was published three years later (Schott, 1832) based mainly on floral characters. The name *Calostigma* was first mentioned in this last work. A detailed description of the genus, including an analysis of both vegetative and floral parts, was made by Endlicher (1837). Schott (1856) presented a treatment of all known species of *Philodendron* until that date, wherein the number of species was tripled compared to the number of species presented by Kunth (1841). The large number of new species was due mainly to new collections. In Schott's (1856) treatment, the species were divided into 22 "greges" (a taxonomic category no longer recognized), based on vegetative characters. These 22 greges were arranged in 7 taxonomic categories (not named), according to the complexity of the leaf blade. Among these greges, two would be at home in section *Calostigma*: *Macrobelium*, number 15, and *Imbea*, number 16, both having as a principal characteristic the presence of a cordate leaf base. A final classification was suggested by Schott in 1860, with very few differences from the treatment presented in 1856.

Pfeiffer (1874) presented a nomenclatural revision for the genus, and in this paper the name *Calostigma* was recognized as defining a section within the genus.

Engler (1878) presented a synopsis for the genus, giving special attention to the Brazilian species. He included 116 species, 47 of which were described as being native to Brazil. The "greges" proposed by Schott (1856, 1860) were left almost intact, being, however, reformulated within sections and subsections. Eleven of Schott's 22 greges were considered in two large sections: *Polyspermium* and *Oligospermium*. The species included in section *Calostigma* by Schott (1856) were considered as belonging to section *Oligospermium* by Engler. Both Engler's further classifications for *Philodendron* (Engler, 1879, 1899) were little modified in relation to his *Flora Brasiliensis* treatment (Engler, 1878).

The last revision including all *Philodendron* species was completed by Krause (1913). Many new species were added in this work, with a total of 222 species. Few changes were made in the infrageneric classification in relation to Engler's last work (Engler, 1899).

Mayo (1990) presented an infrageneric revision of *Philodendron* in which he recognized three subgenera: *Philodendron*, *Pteromischum* (recognized in Krause's treatment (1913) within *Euphilodendron*), and *Meconostigma*. The section *Oligospermium* was considered a synonym of section *Calostigma* (Schott) Pfeiffer (Pfeiffer, 1874).

The species of section *Calostigma* are characterized by having basal or subbasal placentation and typically solitary or few ovules per locule. Owing to its size and diversity, there are no other characters that completely characterize the group (Croat, 1997). According to this last author it includes 5 subsections and 6 series: subsection *Macrobelium* (series: *Macrobelium*, *Ecordata*, *Reticulata*, *Pachycaulia*); subsection *Glossophyllum* (series: *Glossophyllum* and *Ovata*); subsection *Oligocarpidium*; subsection *Buloana* and subsection *Eucardium*. The major change suggested by Croat (1997) in relation to Mayo's (1990) infrageneric treatment was that section *Belocardium* Schott was submerged in *P.* subsect. *Macrobelium*.

The geographic distribution of section *Calostigma* corresponds more or less to the distribution of the entire genus and extends across a wide range of habitats such as forests, swamps, and rocky fields. In Brazil, 26 species have been recognized (Sakuragui, 1999), representing subsections *Macrobelium* and *Glossophyllum* (sensu Croat, 1997).

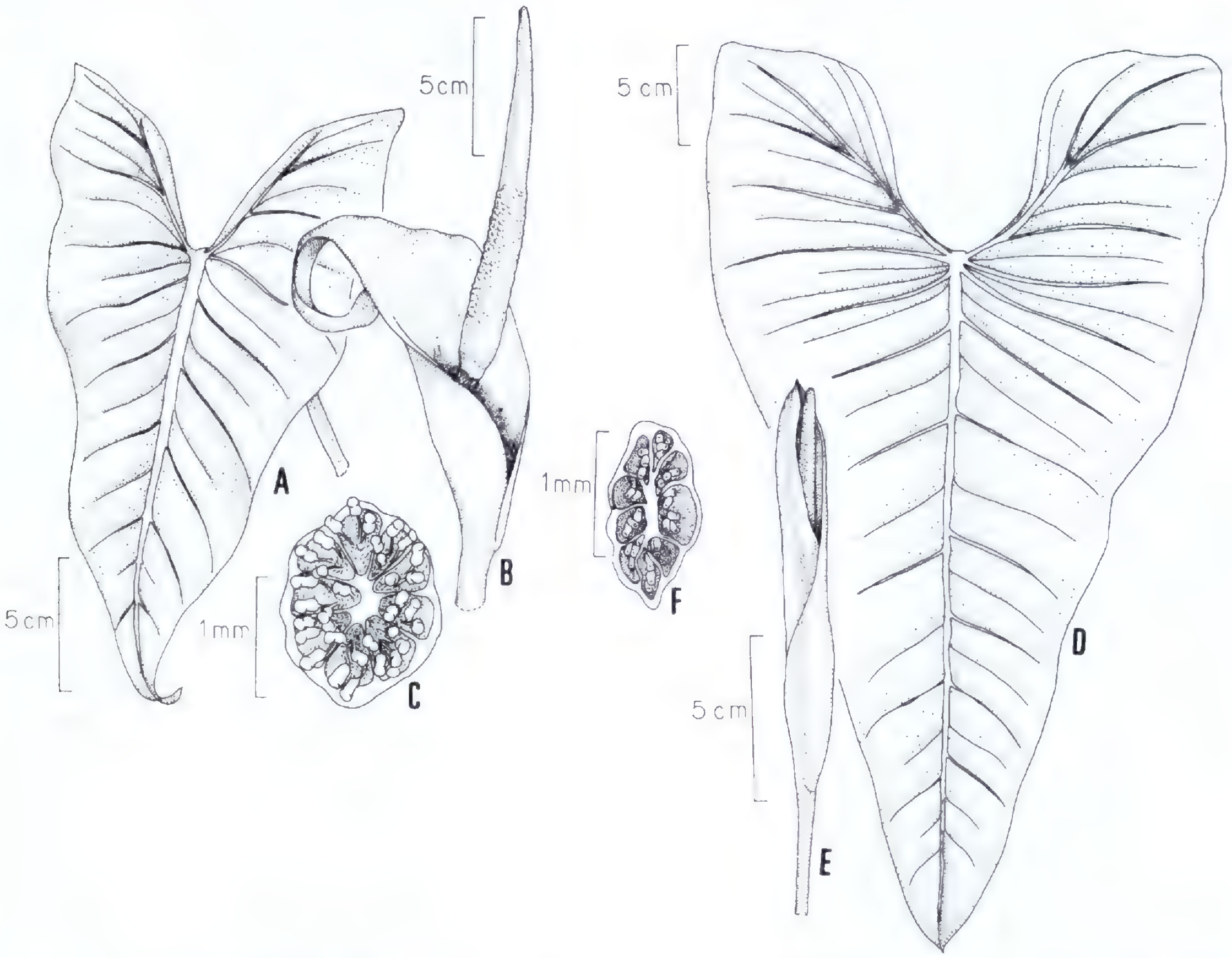


Figure 1. A–C. *Philodendron simonianum* Sakuragui. —A. Leaf. —B. Inflorescence at anthesis. —C. Cross section of the ovary. D–F. *Philodendron vargealtense* Sakuragui. —D. Leaf. —E. Inflorescence. —F. Cross section of the ovary.

Philodendron simonianum Sakuragui, sp. nov. TYPE: Brazil. São Paulo: Mpio. de Natividade da Serra, Pouso Alto–Natividade da Serra road, Mata Atlântica forest, 27 Nov. 1996, *C. M. Sakuragui & L. A. Takahashi 629* (holotype, SPF; isotypes, K, MO). Figure 1A–C.

Haec species *P. appendiculato* affinis sed spadicis zona sterili terminali elongata gradatim angustata, spatha reflexa differt. Lamina foliaris ovata usque ovato-triangularis, subcoriacea, apice acuminata, basi sagittata, nervis lateralibus primariis utrinque 3 vel 4. Spatha ovata, sine constrictione, sub anthesi reflexa. Ovarium 9- ad 11-loculare, loculis 4- vel 5-ovulatis, placenta sub-basali.

Scandent herb. Internodes 2–4 cm long, greenish becoming pale. Prophyll 20–23 × 3 cm, narrowly triangular, green to greenish yellow becoming cream and then brownish red. Petiole 27–39 cm long, green to greenish purple (vinaceous). Leaf blade 36–42 × 14–20 cm, ovate to ovate-triangular, subcoriaceous, paler abaxially, acuminate apically, sagittate basally, anterior lobe 27–40 × 14–23 cm; with 3 or 4 primary lateral veins per side, posterior lobes bluntly acute apically, 7–10.5 × 7–10.5 cm, 7 basal veins, first and second free to the base, third and higher fused to 1.5–2 cm, fifth and sixth fused to 0.8–1.5 cm, posterior rib ± straight, not at all naked along the sinus, sinus triangular, 0.6–1 cm deep. Inflorescences 3 or 4 per sympodium. Peduncle 4–8 cm long. Spathe 12–13.5 cm long, narrowly ovoid, without a medial constriction, reflexed at anthesis, externally greenish becoming white (at anthesis), internally white, reddish purple at base. Spadix 13–14 cm long, fertile male zone 3.2–4 cm long, cream to pinkish cream; apical sterile zone 4–5 cm long, cream becoming grayish pink post anthesis, medial sterile zone 0.5–0.6 cm long, both the medial and apical sterile zones cream becoming grayish pink after anthesis; female zone 4–5 cm long, pale green becoming pale chestnut-brown. Fertile male flowers with stamens 0.8–2 × 0.7–1.2 mm; sterile male flowers with staminodes 1–2 × 0.8–1.2 mm; medial sterile male flowers with staminodes 1.8–2.3 × 0.8–1.5 mm; female flowers with gynoecium 1.2–2 × 1–1.8 mm, cylindrical; ovary with 9–11 locules; ovules 4 or 5 per locule. Berries: not observed.

This species is characterized by the presence of a long, tapering, apical sterile zone in the spadix and a reflexed spathe during anthesis, the latter feature being quite unusual in the genus.

Among Brazilian species of *P.* sect. *Calostigma*, it can be distinguished from *P. appendiculatum* Nadruz & Mayo, a related species that also occurs in this region and has an apical appendix, by the following features: (i) absence of a strong medial spathe constriction (present in *P. appendiculatum*); (ii) spathe internally reddish purple at the base (cream-colored in *P. appendiculatum)*; (iii) apical sterile zone 4–5 cm long, always narrowing toward the tip (2–3.5 cm long and mostly clavate in *P. appendiculatum*).

Philodendron simonianum was collected in the Município of Natividade da Serra, São Paulo, growing as a hemiepiphyte on trees and shrubs in a humid, shady, dense forest near the coast.

The species is named after Simon Mayo for his enormous contribution to the knowledge of Brazilian aroids.

Philodendron vargealtense Sakuragui, sp. nov. TYPE: Brazil. Espírito Santo: Mpio. de Vargem Alta, São José da Fruteira, 9 Dec. 1956, *Pereira 2300* (holotype, RB). Figure 1D–F.

Haec species *P. myrmecophilo* similis sed ovarii loculis pluriovulatis, placenta sub-basali differt. Lamina foliaris triangulari-ovata, chartacea usque ad subcoriaceam, apice acuta, basi sagittata, nervis lateralibus primariis utrinque 5 vel 6. Spatha cymbiformis medio moderate constricta. Ovarium 8- vel 9-loculare, loculis 6- vel 7-ovulatis, placenta sub-basali.

Scandent herb. Internodes 1.5–3 cm long, greenish becoming grayish. Prophyll 25–30 × 3–4 cm, narrowly triangular, green to greenish cream and then becoming brownish. Petiole 39–42 cm long, green sometimes vinaceous apically. Blade 30–56 × 19–25 cm, oval-triangular, chartaceous to subcoriaceous, acute apically, sagittate basally, anterior lobe 27–36 × 19–25 cm, with 4 or 5 primary lateral veins per side, interprimary lateral veins distinct, posterior lobes 11.5–13 × 10–11 cm, 4 or 5 basal veins, the first free to the base, the second fused to 0.9–1.5 cm, the third and fourth fused to 2–2.5 cm, posterior rib straight, naked for 2–2.5 cm along the sinus, sinus hippocrepiform, 2–2.5 cm deep, 3–3.5 cm wide. Inflorescence 1 or 2 per sympodium. Peduncle 3–6 cm long. Spathe 12–14 cm long, cymbiform with a moderate medial constriction, white externally becoming green post anthesis, bronze internally post anthesis. Spadix 9–11 cm long; male zone 6–7 cm long; medial sterile zone 1–1.5 cm long; female zone 4.5–5.5 cm long. Fertile male flowers with stamens 0.8–1.5 × 1–1.3 mm, sterile male flowers with staminodes 1.5–2 × 1.3–1.8 mm; fertile female flowers with gynoecium 0.9–1.8 × 0.7–1.5 mm; ovary 8–9 locules; ovules 6–7 per locule. Berries: not observed.

Philodendron vargealtense can be distinguished from the other Brazilian species of *P.* sect. *Calostigma* by the following combination of features: anterior lobe with 4 or 5 primary lateral veins, posterior lobe with 4 or 5 basal veins, interprimary lateral veins distinct, leaf blade sagittate basally. The leaves of *P. vargealtense* are rather similar to those of *P. myrmecophilum* Engler, but *P. vargealtense* differs from this species in presenting 6 or 7 ovules per locule with subbasal placentation while in *P. myrmecophilum* the locules are uniovulate with basal placentation.

The species occurs in humid and shady habitats as scandent or rupicolous. It is known so far only from the type locality.

Acknowledgments. The author is grateful to Daniela Zappi, Simon Mayo, and Tom Croat for comments and suggestions.

Literature Cited

Croat, T. B. 1997. A revision of *Philodendron* subgenus *Philodendron* (Araceae) for Mexico and Central America. Ann. Missouri Bot. Gard. 84: 311–704.

Endlicher, S. 1837. Genera Plantarum 1(3): 237.

Engler, A. 1878. Araceae. *In* C. P. F. von Martius, Flora Brasiliensis 3(2): 25–224, t. 2–52.

———. 1879. Araceae. *In* A. & C. deCandolle, Monographiae Phanerogamarum, Vol. 2. Masson, Paris.

———. 1899. Beiträge zur Kenntnis der Araceae IX. 16. Revision der Gattung *Philodendron* Schott. Bot. Jahrb. 26: 509–564.

Krause, K. 1913. Araceae–Philodendroideae–Philodendreae–Philodendrinae. *In* A. Engler (editor), Das Pflanzenreich 60 (IV.23Db): 1–143.

Kunth, C. S. 1841. Enumeratio Plantarum 3: 46–52. Stuttgart & Tübingen.

Mayo, S. J. 1990. History and infrageneric nomenclature of *Philodendron* (Araceae). Kew Bull. 45: 37–71.

Pfeiffer, L. 1874. Nomenclator botanicus. Kassel.

Sakuragui, C. M. 1999. Taxonomia e Filogenia de *Philodendron* sect. *Calostigma* (Schott) Pfeiffer no Brasil. Dissertation, Instituto de Biociências, University of São Paulo, Brazil.

Schott, H. W. 1829. Für Liebhaber der Botanik. Wiener Zeitschr. Kunst, Literatur, Theater und Mode 1829 (3) 94: 779–780.

———. 1832. Araceae. Pp. 16–22 *in* H. W. Schott & S. Endlicher, Meletemata Botanica. C. Gerold, Vienna.

———. 1856. Synopsis Aroidearum. Typis congregationis mechitharisticae, Vienna.

———. 1860. Prodromus systematis Aroidearum. Typis congregationis mechitharisticae, Vienna.

New *Ouratea* Species (Ochnaceae) from Venezuela and Adjacent Countries

Claude Sastre

Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle, 16 rue Buffon 75005 Paris, France

ABSTRACT. Descriptions and illustrations are provided for the following new species: *Ouratea lajaensis* Sastre and *O. arbobrevicalyx* Sastre (sect. *Kaieteurea*), *O. kanukuensis* Sastre, *O. pseudomarahuacensis* Sastre (sect. *Ouratea*), *O. multibracteata* Steyermark ex Sastre, *O. heterobracteata* Sastre (sect. *Ouratella*), *O. vieirae* Sastre, *O. papulosa* Sastre, *O. orisina* Sastre (sect. *Caducae*, with spicate inflorescences), *O. saldariagae* Sastre, *O. pulverulenta* Sastre, *O. obovata* Sastre (sect. *Caducae*, with short, paniculate inflorescences), *O. fusiformis* Sastre, *O. megaphylla* Sastre, *O. maguirei* Sastre, *O. rorida* Sastre, *O. elongata* Sastre, *O. maigualidae* Sastre (sect. *Caducae*, with large, paniculate inflorescences). In addition, a new combination is made for *Ouratea stipulata* (Vellozo) Sastre (basionym *Ochna stipulata* Vellozo), and a short biogeographical synthesis of the *Ouratea* in the Guayana Shield is presented.

Key words: Ochnaceae, *Ouratea*, Venezuela.

In a recent paper (Sastre, 1995), in preparation of the Ochnaceae treatment for the *Flora of the Venezuelan Guayana*, I described eight new species from Venezuela and adjacent countries of *Ouratea* in sections *Cardiocarpae* (Engler) Sastre, *Ouratea*, and *Ouratella* (Tieghem) Sastre. This current paper contains new species in sections *Kaieteurea* (Dwyer) Sastre, *Ouratea*, *Ouratella* (Tieghem) Sastre, and *Caducae* Sastre from Venezuela and adjacent countries. Section *Caducae* is here divided into three groups: (1) taxa with spiciform inflorescences, (2) taxa with short paniculate inflorescences (< 6 cm long), (3) taxa with large paniculate inflorescences (> 6 cm long).

Ouratea sect. **Kaieteurea** (Dwyer) Sastre, Bull. Mus. Natl. Hist. Nat. 4° sér. 10, sect. B Adansonia 1: 50. 1998. *Kaieteurea* Dwyer, Bull. Torrey Bot. Club 70: 50. 1943.

Inflorescence terminal or axillary; flowers with 3–4 sepals united in 2–3 parts, and 5(–7, *O. articulata* Sastre) carpels; fruits with sepals caducous or persistent and the carpels vertical.

1. **Ouratea lajaensis** Sastre, sp. nov. TYPE: Venezuela. Amazonas: Dept. Atures, 15 km N de Puerto Ayacucho, E de la comunidad Picatonal, al pié de una laja, 18 Apr. 1988, *C. Sastre & E. Guttierez 8567* (holotype, P; isotype, VEN). Figure 1.

Ab *Ouratea polyantha* Triana & Planchon foliis pruinosis, margine integra, inflorescentiis brevibus et floribus pedunculo crasso, differt. Ab *O. brevicalyce* Maguire & Steyermark foliis pruinosis, inflorescentiis brevibus, floribus pedunculo crasso et alabastro majore (ca. 1 cm longo vs. 3–4 mm longo), differt. Ab *O. thyrsoidea* Engler foliis pruinosis ovatis non obovatis, inflorescentiis brevibus, differt.

Treelet 3 m tall, branches glabrous. Leaf blades coriaceous pruinose, elliptic or ovate, 4.5–10 × 2.5–4.5 cm, apex mucronate, base obtuse or subcordate, margin entire, principal vein salient on lower surface, with 8–12 unpaired lateral veins on each side of the principal vein, ascending, evident on lower surface between the smaller, faintly evident, subparallel veins; petiole 5 mm long. Inflorescence terminal, paniculate, 3–4 cm long. Peduncle 5 mm long, thick; sepals 5, united in 2 parts (3 + 2), 9 mm long; petals 5, obovate, 10 × 5 mm (in bud); stamens 10, 8 mm long (in bud); style 9 mm long (in bud), carpels 5. Fruit not seen.

Distribution. Known only from the type collection made near Puerto Ayacucho, Amazonas state, Venezuela.

Ouratea lajaensis belongs to the same section as *O. polyantha*, *O. brevicalyx*, and *O. thyrsoidea*. In this species group, *O. lajaensis* has the smallest inflorescences (3–4 cm long) and *O. brevicalyx* the smallest flowers (3–4 mm long). *Ouratea lajaensis* and *O. thyrsoidea* have thick floral peduncles. *Ouratea thyrsoidea* has broadly obovate leaf blades, while the leaves of *O. lajaensis* are ovate or elliptic. *Ouratea lajaensis* was found at the base of a granitic outcrop (laja) in a dry place. *Ouratea polyantha* occurs in the Colombian and Venezuelan "llanos" in damp riversides or in wet places, including along the middle of the Río Orinoco. *Ouratea brevicalyx* occurs in Venezuelan savannas near affluents of the

Figures 1–4. —1. *Ouratea lajaensis* Sastre, *Sastre & Guttierez 8567* (holotype, P). —2. *Ouratea kanukuensis* Sastre, *Jansen-Jacob et al. 262* (holotype, P). —3. *Ouratea pseudomarahuacensis* Sastre, *Steyermark et al. 101785* (holotype, P). —4. *Ouratea multibracteata* Steyermark ex Sastre, *Guánchez & Melgueiro 3492* (holotype, P).

upper Río Orinoco (Dept. Río Negro). *Ouratea thyrsoidea* is a riverside species occurring along the upper Rio Negro (Brazil) and in the Río Negro Department in southern Venezuela.

2. **Ouratea arbobrevicalyx** Sastre, sp. nov. TYPE: Venezuela. Amazonas: Río Casiquiare, entre Curimacare y El Porvenir, 2°00′N, 66°30′W, selvas pluviales cercanas y a las orillas, 150 m, 16–27 Jan. 1987 (fl), *Stergios, Aymard & Estévez 9807* (holotype, P; isotypes, MO, P, PORT).

Ab *O. brevicalyce* Maguire & Steyermark, habitu (arbor 15–25 m alta vs. frutex vel arbor parva 2–5 m altus) et nerviis inaequalibus (vs. aequalibus), differt.

Tree, 15–25 m high, stems glabrous. Leaves membranaceous, a few asymmetric, arcuate, elliptic, 7–14 cm long, 3–4.2 cm wide; base rounded, apex acute or acuminate, sometimes with an arista 2 mm long, margin undulate, crenulate; principal vein salient below, secondary veins unequal, some arcuate ascending along the margin between 3 and 10 smaller, fine, horizontal, subparallel and straight or a few arcuate, not reaching the margin; petiole 5–7 mm long. Inflorescence terminal, branching, 10–13 cm long. Peduncle 4–5 mm long; sepals 5 united in 2–3 parts, 4–5 mm long, petals 5, free, obovate, ca. 5 × 4 mm, stamen 10, sessile, 3–3.5 mm long, style ca. 3 mm long. Fruits not seen.

Ouratea arbobrevicalyx is allied to *O. brevicalyx* Maguire & Steyermark. It differs by the habit (tree 15–25 m high vs. shrub or small tree 2–5 m high) and the venation: secondary veins unequal vs. subequal.

Distribution. *Ouratea arbobrevicalyx* occurs along the Ríos Siapa and Casiquiare in rainforest, and *O. brevicalyx* occurs about 400 km to the north in the Ríos Manapiare and Ventuari region and at the base of Cerro Paru and Coro-Coro, Serrania Yutaje.

Paratypes. VENEZUELA. **Amazonas:** Río Siapa, entre la Piedra de la Natividad y la boca del Emoni, 2°15′N, 66°25′W, selvas pluviales cercanas y a las orillas, 175 m, 16–27 Jan. 1987 (fl), *Stergios et al. 9902* (MO, P, PORT); entre la Piedra del Cabezón y la Piedra de la Natividad, 16–27 Jan. 1987 (fl), *Stergios et al. 9865* (MO, P, PORT).

Ouratea sect. **Ouratea**

Inflorescence terminal; flowers with 5 sepals distinct and 5 carpels; fruits with sepals persistent and the carpels vertical.

3. **Ouratea kanukuensis** Sastre, sp. nov. TYPE: Guyana. Kanuku Mts., Rupununi River, Puwib R. near the "farm" of the Captain of the Sandcreek, along river, 03°07′N, 59°26′W, 80–100 m, 16 Feb. 1985 (fl), *Jansen-Jacob et al. 262* (holotype, P; isotype, U). Figure 2.

Ab *Ouratea subamplexicauli* Maguire & Steyermark, foliis non subamplexicaulis, lamina minore (3–6 cm longa vs. 4.5–12.5 cm), inflorescentia spiciformi non paniculata, floribus majoribus (sepalis 8–9 mm longis [11 mm in fructu] vs. 0.5–0.6 mm) differt. Ab *O. mazaruniensi* A. C. Smith & Dwyer, lamina minore (3–6 cm longa vs. 4–12.5 cm), non crenulata, inflorescentia spiciformi non paniculata, floribus majoribus, fructus sepalis persistentibus differt. Ab *O. medinae* Maguire & Steyermark foliis nervis II et III anastomosantibus et bene visibilibus, fructus sepalis persistentibus, differt.

Tree, branches glabrous. Leaf blades coriaceous, 3–6 × 2–3.5 cm, ovate, apex obtuse and acuminate, base cordate or sometimes obtuse, margin entire, principal vein salient on both surfaces, secondary veins subequal, subparallel, anastomosing with the tertiary veins, salient; petiole short, 2–4 mm long. Inflorescence terminal, spicate, 6–7 cm long; peduncle 5–7 mm long; sepals 5, narrowly ovate, 8–9 × 2–3 mm; petals 5, obovate, 10–12 × 5–6 mm; stamens 11 mm long. Young fruits with peduncle 6–7 mm long, sepals persistent, 11 × 4 mm, carpels 1–3, mature fruits not seen.

Distribution. Known only from the type specimen collected in the Kanuku Mountains of Guyana.

Ouratea kanukuensis, O. subamplexicaulis (from Bolívar, Venezuela), *O. mazarunensis* (from Guyana), and *O. medinae* (from Amazonas, Venezuela) are all similar in having small, cordate leaves. The first two species, with their persistent sepals in the fruit, belong to section *Ouratea,* while the two other species, with deciduous sepals, belong to section *Caducae. Ouratea kanukuensis* differs from *O. subamplexicaulis* by its smaller leaves (3–6 cm long vs. 4.5–12.5 cm), longer flowers (sepals 8–9 mm long vs. 5–6 mm), and its spiciform (vs. paniculate) inflorescence.

4. **Ouratea pseudomarahuacensis** Sastre, sp. nov. TYPE: Venezuela. Apure: Reserva Forestal San Camilo, Cerro Nulita, oeste de la carretera, 4.5–5 km al norte del caserío San Camilo (El Nula), a lo largo meridional del Río Nulita, selva siempreverde, 280 m, 3 Apr. 1968, *J. A. Steyermark, G. Bunting & C. Blanco 101785* (holotype, P; isotype, VEN). Figure 3.

Ab *Ouratea marahuacensi* Maguire & Steyermark nervis lateralibus impressis bene visibilibus, differt. Ab *O. apurensi* Sastre nervis lateralibus impressis et flores mi-

noribus, sepalis 5–6 mm longis (vs. ca. 10 mm), differt. Ab *O. longistyla* Maguire & Steyermark foliorum laminis longioribus, nervis lateralibus bene visibilibus et sepalis fructuum minoribus 5–6 mm longis (vs. 10 mm), differt.

Tree 15 m tall, branches glabrous. Leaf blades lanceolate, 7.5–9 × 3–4 cm, apex acute, base shortly attenuate, margin serrulate, principal vein raised in a furrow on upper surface, salient on the lower surface, lateral veins impressed on both surfaces, with 8–12 unpaired lateral veins on each side of the principal vein ascending between the small, subparallel veins; petiole ca. 5 mm long. Inflorescence paniculate, terminal, 4–5 cm long. Peduncle ca. 3 mm long; sepals 5, narrowly ovate, 5–6 × 1.5–2 mm; petals narrowly elliptic, ca. 8 × 2.5 mm; stamens 10, 5.5–6 mm long, style 4 mm long. Fruits with 5 sepals, torus subspheric, 4 mm diam., carpels ellipsoid, 4.5 × 3 mm.

Distribution. Known only from the type collection made in the Reserva Forestal San Camilo, Apure state, Venezuela.

Ouratea pseudomarahuacensis is similar to *O. marahuacensis* (Amazonas, Venezuela), *O. apurensis* (Apure, Venezuela), and *O. longistyla* (Amazonas, Venezuela). The first two species have smaller flowers (less than 6 mm long) than the second two (ca. 1 cm long), and *O. pseudomarahuacensis* is the only one of the four that has an impressed vein.

Ouratea sect. **Ouratella** (Tieghem) Sastre, Bull. Mus. Natl. Hist. Nat. 4° sér. 10, sect. B Adansonia 1: 61. 1998. *Ouratella* Tieghem, Ann. Sci. Nat. Bot., sér. 8, 16: 289. 1902.

Inflorescence axillary, rarely terminal, spicate or paniculate; flowers with 5 distinct sepals and 5 carpels; fruit with carpels vertical.

5. **Ouratea stipulata** (Vellozo) Sastre, comb. nov. Basionym: *Ochna stipulata* Vellozo, Fl. Flum.: 210. 1825. TYPE: Vellozo, Fl. Flum.: tab. 91.

6. **Ouratea multibracteata** Steyermark ex Sastre, sp. nov. TYPE. Venezuela. Amazonas: Dept. Atures, riberas del Río Autana, en el remanso del raudal "Cegüera," 4°48′N, 67°28′W, bosque ribereño, 100 m, 11 nov. 1984, *F. Guánchez & E. Melgueiro 3492* (holotype, P; isotype, VEN not seen). Figure 4.

Ab *Ouratea soderstromii* Sastre, inflorescentiis magnis, 15–20 cm longis (vs. 6–8 cm), ramosissimis, differt. Ab *Ouratea stipulata* inflorescentiis magnis (15–20 cm longis vs. 2–4 cm), paniculatis, axillaribus et laminis magnis (10–15 cm longis vs. 3.5–5 cm), differt.

Tree 6–8 m tall, branches glabrous. Leaf blades chartaceous, 10–15 × 4–6 cm, oblong-elliptic, apex acuminate, base obtuse, margin crenulate, principal vein salient on the lower surface, lateral veins unequal, some arcuate ascending between smaller, fine, parallel, and straight ones; petioles 9–11 mm long. Inflorescence paniculate, axillary, or terminal on secondary branches, 15–20 cm long. Bracts many, persistent, strongly appressed, 2–2.5 × 1 mm, oblong-lanceolate, acute; peduncle 6–11 mm long, with 1–3 small bracts ca. 1 mm long; sepals 5, ca. 4 × 1.5–1.8 mm, lingulate, obtuse; petals 5, subflabelliform, ca. 4 × 5.5 mm, rounded at summit; stamens 10, apiculate, ca. 5 mm long; style 4 mm long. Fruit with torus disciform, 10-lobed, 0.5 × 1.5 mm, immature carpels 0.5 mm long.

Distribution. Known only from the type locality, along the Río Autana, Amazonas, Venezuela.

With small flowers as in *Ouratea soderstromii* Sastre, *O. multibracteata* is near a species group occurring in southern Brazil. *Ouratea multibracteata* has some persistent and setaceous bracts as in *O. stipulata*, but differs by its longer inflorescences (15–20 cm long vs. 2–4 cm) and longer leaves (10–15 cm vs. 3.5–5 cm). *Ouratea multibracteata* differs from *O. soderstromii*, from Guyana and Venezuela (Bolívar, Río Caroní region), by its large and many-branched inflorescences (vs. unbranched or few-branched and 6–8 cm long).

7. **Ouratea heterobracteata** Sastre, sp. nov. TYPE: Venezuela. Amazonas: Río Guainía, sabanita at Victorino, 135 m, 14 Apr. 1953, *B. Maguire & J. J. Wurdack 35706* (holotype, P; isotype, NY). Figure 5.

Ab *Ouratea ferruginea* Engler, foliis ovatis (oblongis ad obovatis), inflorescentiis axillaribus ramosis, alabastris parvis 5 mm longis (vs. 10 mm) differt.

Treelet 3 m tall, stems pilose. Leaf blades ovate, 25–34 × 4.5–8 cm, apex acute, base attenuate, margin serratulate, principal vein salient on the lower surface, some lateral veins ascending and salient on lower surface between smaller subparallel ones; petiole thick, 1–1.5 cm long. Inflorescence axillary, paniculate, 12–16 cm long, axis pilose, hairs unicellular, ca. 1 mm long; bracts, at the base, 2–3; scales 3.5–6 × 2–4 mm, paired, united at the base with an arista between them, borne at the base of the lower branches of the inflorescences; scales 3–4 × 1–3 mm, paired, entirely united, with or without arista borne near the summit of the inflorescence. Peduncle ca. 5 mm long, pubescent, with short hairs ca. 0.1 mm long; sepals 5, elliptic-ovate,

Figures 5–8. —5. *Ouratea heterobracteata* Sastre, *Maguire & Wurdack 35706* (holotype, P). —6. *Ouratea vieirae* Sastre, *Vieira et al. 122* (holotype, P). —7. *Ouratea papulosa* Sastre, *Eupunino 184* (holotype, P). —8. *Ouratea orisina* Sastre, *Stergios 10718* (holotype, MO).

6 × 2 mm; petals 5, spathulate, 8–9 × 5 mm; stamens 10, 5 mm long; carpels 5, velvety, style 3.5–4 mm long. Fruit glabrous with peduncle ca. 7 mm long, torus subclaviform, curved, carpels ovoid, 7 × 4–5 mm.

Distribution. Known only from the type collection made along the Río Guainía, Amazonas, Venezuela.

Because of the pilose inflorescence and shape of the fruit, the type collection was originally identified as *O. ferruginea* Engler (sect. *Caducae*), an Amazonian species also occurring in Venezuela. However, *Ouratea heterobracteata*, with its two types of bracts, its small buds, and its ramified axillary inflorescences, is quite distinct from *O. ferruginea*.

Ouratea sect. **Caducae** Sastre, Novon 5: 194. 1995.

Inflorescence terminal; flowers with 5 sepals and 5 carpels; fruits with carpels vertical and without sepals.

WITH SPICATE INFLORESCENCES

8. Ouratea vieirae Sastre, sp. nov. TYPE: Brazil. Amazonas: Transamazônica-Trecho de Humaita-Itaituba, Km 135 de Humaita, perto do Km 895 da Transamazônica, 8°7.5′S, 61°49′W, campina de areia branca, 24 Sep. 1979 (fr), *Vieira et al. 122* (holotype, P; isotypes, INPA, NY). Figure 6.

Ab *Ouratea verruculosa* Engler foliis minoribus (7–10 cm longis vs. 15–28 cm), nerviis II et III paucis visibilibus et excretis papillosis et non verrucosis, differt. Ab *O. ferruginea* Engler foliis minoribus (7–10 cm longis vs. 15–25 cm), nerviis II et III paucis visibilibus et excretis transluciidis, differt.

Shrub 1.5 m tall, branches glabrous. Leaf blades coriaceous, 7–10 × 2.5–4 cm, ovate, apex acuminate, base attenuate, margin serrulate, undulate, principal vein salient on lower surface, lateral veins faintly evident, with 6–8 unpaired arcuate veins on each side of principal vein, with fine, parallel intersecondaries; petiole 3–4 mm long. Inflorescence terminal, spicate, short, 2–5 cm long, axes papillate. Flowers not seen. Fruits with cylindrical carpophore 6 mm diam., 4 mm high, carpels 1 or 2, subspherical ca. 3 mm diam., peduncle 9–10 mm long.

Distribution. Known only from the type collection made in the Rio Madeira basin, Amazonas, Brazil.

Ouratea vieirae, with its terminal, spicate inflorescence with papillate axes, is in the same species group as *O. verruculosa* from Rio Negro (Brazil) and *O. ferruginea*, occurring in Brazil, Colombia, and Venezuela. It differs from those species by having smaller leaves (7–10 cm long vs. 15–28 cm) and only faintly evident lateral veins.

9. Ouratea papulosa Sastre, sp. nov. TYPE: Brazil. Bahia: S. Cruz de Cabralia, Res. Biol. Pau-Brasil, 24 Jan. 1972 (fl), *A. Eupunino 184* (holotype, P; isotype, NY). Figure 7.

Ab *Ouratea verruculosa* Engler, nervis lateralibus inaequalis, petiolo majore et excretis papillosis vs. verrucosis differt.

Shrub or small tree, 1–5 m tall, branches glabrous. Leaf blades coriaceous, elliptic, 10–26 × 3.5–7 cm, apex acuminate, base attenuate or rounded, margin undulate, crenulate, principal vein salient on the lower surface with 15–20 unpaired lateral veins on each side of the principal vein, ascending, impressed between the small, subparallel, impressed veins; petiole 8–15 mm long, thick. Inflorescence terminal, spicate, 2–13 cm long, axes papillate. Peduncle papillate, 5–6 mm long; sepals 5, ovate, 5–6 × ca. 2 mm; petals 5, obovate, 9–10 × 4–5 mm, stamens 10, 5–6 mm long, mucronate; style 5–6 mm long. Fruits with papillate peduncle, carpophore subconical, 4–5 mm high, 6–7 mm diam., carpels 1–2, ovoid, ca. 1 cm high.

Distribution. Bahia, Brazil.

The type and paratypes of *Ouratea papulosa* were previously determined as *O. verruculosa*, a species found along the Rio Negro in northern Brazil. *Ouratea papulosa* differs from *O. verruculosa* by the secondary veins not subequal, the length of the petiole (8–15 mm vs. 5–6 mm), and by having papillate (vs. tuberculate) inflorescence axes and peduncles. *Ouratea papulosa* and *O. vieirae* belong to a group in the section *Caducae* that is characterized by spicate inflorescences with papillate, verrucose, or ferrugineous axes.

Paratypes. BRAZIL. **Bahia:** Santa Cruz de Cabralia, Reserva Biologica de Pau-Brasil, 15 Sep. 1971 (fl), *T. S. Santos 1927* (NY, P), 30 Sep. 1971 (fl), *A. Eupunino 8* (NY, P) ; 7 km NE estação, 80–100 m, 16°23′S, 39°8′W, 14 Aug. 1979 (fl), *S. Mori et al. 12174* (NY, P); Porto Seguro, Parque Nacional, 6 Apr. 1972 (fr), *R. S. Pinheiro 1821* (NY, P); Saida de Eunapolis a Porto Seguro, mata costeira, 23 Sep. 1968 (fl), *Almeida & Santos 78* (K, P); Rôdovia BR5, 16 km S Eunapolis, 28 Sep. 1966, *Belem & Pinheiro 2670* (P, UB).

10. Ouratea orisina Sastre, sp. nov. TYPE: Venezuela. Bolívar: Medio Río Paragua, Medio Río Oris, en las alrededores del Campamento Turumbán. 6°21′36″N, 63°45′27″W, selvas húmedas, ribeñeras y de lomerío, 300 m, 13 May–13 June (fr), *B. Stergios 10718* (holotype, MO; isotype, PORT). Figure 8.

Ab *Ouratea culminicola* Maguire & Steyermark lamina obovata, margine undulata non serrata, nervis lateralibus inaequalibus, nervis III paucis visibilibus differt.

Tree, branches glabrous. Leaf blades obovate, 10.5–17 × 3–5.5 cm, base attenuate, apex acuminate, margin undulate, principal vein salient on both surfaces with 11–13, unpaired, lateral, arcuate veins on each side with fine and subparallel intersecondaries, tertiary veins faintly evident. Inflorescence spiciform, terminal, 8 cm long. Flowers not seen. Fruit with a subspheric torus ca. 5 mm diam., carpels ellipsoid, 7 × 6 mm.

Distribution. Known only from the type collection made at the middle Río Oris, Bolívar, Venezuela.

Ouratea orisana is similar to *O. culminicola* but differs by having leaves with undulate margins and two distinct types of lateral veins (vs. leaves with serrate margins and subequal lateral veins). Both species occur in the Río Paragua Basin in Bolívar state, *O. orisana* along the Río Oris at 300 m elevation and *O. culminicola* near the Río Carapo on the plateau of Cerro Guaiquinima, at 730–750 m elevation.

Ouratea sect. **Caducae**

WITH SHORT PANICULATE INFLORESCENCES

11. Ouratea saldariagae Sastre, sp. nov. TYPE: Venezuela. Amazonas: San Carlos de Río Negro, ca. 20 km S of confluence of Río Negro and Brazo Casiquiare, 4.3 km NNE of San Carlos on Solano road, IVIC main study site, 1°59′N, 67°03′W, 119 m, 28 Jan. 1983 (fr), *J. Saldariaga s.n.* (holotype, MO). Figure 9.

Ab *Ouratea melinonii* Van Tieghem foliis coriaceis petiolatis, non sessilis, 5.5–9.5 cm longis vs. 8–16 cm et inflorescentiis brevibus (2.5 cm vs. 3–10 cm) differt.

Tree 12 m tall, branches glabrous. Leaf blades coriaceous, elliptic-obovate, undulate, 5.5–9.5 × 1.7–4 cm, apex acuminate, base attenuate, margin crenulate, principal vein salient on the lower surface with 6–8 unpaired lateral veins on each side of the principal vein, ascending, salient on lower surface, sunken on upper surface between the small, subparallel veins, a few salient on lower surface; petiole 6–8 mm long. Inflorescence terminal, spicate or paniculate, 2.5–3 cm long, axes papillate. Flowers not seen. Fruit peduncle papillate, 1–1.2 cm long, carpophore subcylindric, 5–8 mm high, 9–11 mm diam., carpels 1, ovoidal, 8 × 5 mm.

Distribution. Known only from the type collection made near San Carlos de Río Negro, Amazonas, Venezuela.

Ouratea saldariagae is similar to *O. melinonii* Tieghem from French Guiana and Suriname, but differs from it by having smaller, petiolate leaves (5.5–9.5 cm long vs. 8–16 cm and sessile) and smaller inflorescences (2.5 cm long vs. 3–10 cm).

12. Ouratea pulverulenta Sastre, sp. nov. TYPE: Venezuela. Amazonas: Dpto. Atabapo, transecto desde campamento del MARNR en Ocamo (Santa María de Los Guaicas), 2°50′N, 65°14′W, 135–140 m, 12 Nov. 1982, *F. Guánchez 2188* (holotype, P; isotype, MO). Figure 10.

Ab *Ouratea saldariagae* Sastre foliis pulverulentis pagina superiore, pruinosis pagina inferiore, nerviis subaequalibus, fructus pedunculo glabro, toro ca. 3 mm diam. vs. 9–11 mm, differt.

Tree 5 m tall, branches glabrous. Leaf blades coriaceous, undulate, pulverulent on upper surface, pruinose on lower surface, elliptic, 6–9 × 2–3 cm, apex acuminate, base attenuate, margin entire, principal vein salient above, lateral veins subequal. Inflorescence terminal, paniculate, 4–6 cm long, flowers not seen. Torus subcylindric, mammillate, 2 mm high, 3 mm diam., carpels not seen.

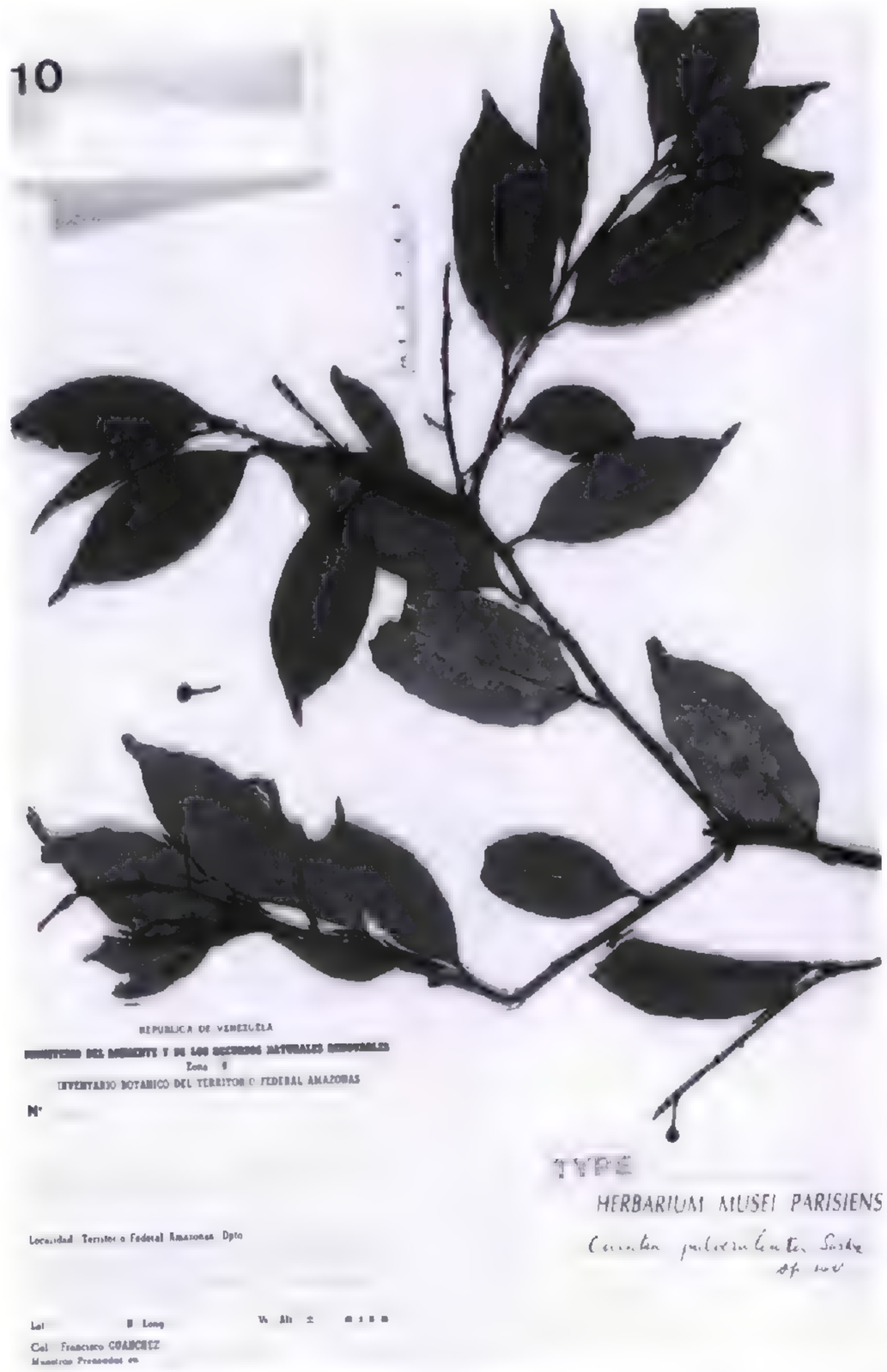
Distribution. Known only from the type collection made near the Río Ocamo, Amazonas, Venezuela.

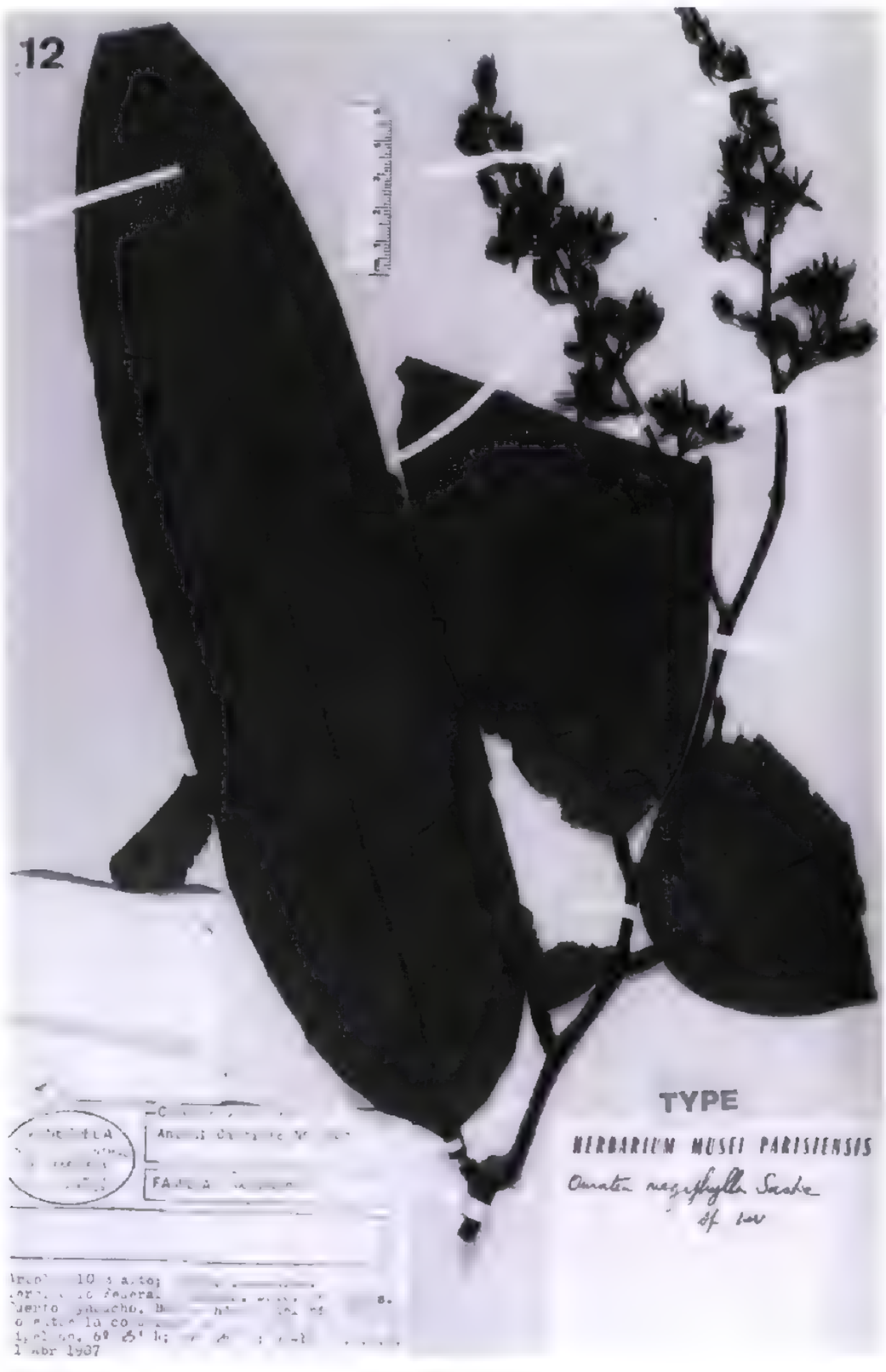
Ouratea pulverulenta is characterized by pulverulent leaves and the very small torus in the fruit. It resembles *O. saldariagae* also from near San Carlos de Río Negro, Amazonas, Venezuela, but differs by having pulverulent-pruinose (vs. glabrous) leaves, a mammillate (vs. papillate) peduncle, and a 2 × 3 mm torus (vs. 5–8 × 9–11 mm).

13. Ouratea obovata Sastre, sp. nov. TYPE: Venezuela. Amazonas: Dept. Atures, Cerro Sipapo (Paraque), upper East Basin, along water course, 5000–5500 ft., 20 Jan. 1949, *B. Maguire & L. Politi 28457* (holotype, NY; isotype, VEN). Figure 11.

Ab *Ouratea yapacana* Sastre, laminis 7–12 cm longis,

MISSOUR BOTANICAL GA HERBARIU
Nº 30199





Figures 9–12. —9. *Ouratea saldariagae* Sastre, *Saldariaga s.n.* (holotype, MO). —10. *Ouratea pulverulenta* Sastre, *Guánchez 2188* (holotype, P). —11. *Ouratea obovata* Sastre, *Maguire & Politi 28457* (holotype, NY). —12. *Ouratea megaphylla* Sastre, *Castillo 2341* (holotype, P).

4.5–6 cm latis (vs. 10–12 × 2.5–3 cm), glabris, non revolutis, inflorescentia terminali, differt. Ab *O. platicauli* Sastre, ramis teretibus, laminis 7–12 cm longis, 4.5–6 cm latis (vs. 13–15 × 4–5 cm), inflorescentia terminali, differt.

Shrub 3 m tall, branches glabrous. Leaf blades coriaceous, 7–12 × 4.5–6 cm, obovate, flat, apex retuse to emarginate, base obtuse to truncate, margin entire, a few revolute, principal vein salient above, lateral veins subequal, subparallel and anastomosing with the tertiary veins; petiole very short, 1–2 mm long. Inflorescence paniculate, terminal, 4–6 cm long. Flowers not known. Fruits with torus conical, 13–14 mm high, 12–13 mm wide, carpels obovate, 9 × ca. 7 mm, peduncle ca. 1.5 cm long.

Distribution. Known only from the type collection from Cerro Sipapo, Amazonas, Venezuela, at 1525–1675 m elevation, along a water course (*O. sipapoensis* Maguire & Steyermark is known near the summit at 1700–1800 m alt. in thickets).

With its obovate leaves, *Ouratea obovata* resembles *O. yapacana* Sastre from Venezuela (Amazonas, Cerro Yapacana) and *O. platicaulis* Sastre from Bahia, Brazil, but differs from both of them by having terminal (vs. axillary) inflorescences.

Ouratea sect. **Caducae**

WITH LARGE PANICULATE INFLORESCENCES

14. Ouratea fusiformis Sastre, sp. nov. TYPE: Venezuela. Amazonas: Selvas pluviales cerca y en las orillas del Río Casiquiare, entre Curimacare y Buena Vista, 2°00′N, 66°33′W, 150 m, 20–30 Oct. 1986 (fr), *B. Stergios et al. 9652* (holotype, P; isotypes, MO, PORT). Figure 13.

Ab *Ouratea macrocarpa* Sastre, pedunculo saepe papilloso, lamina membranacea, nerviis III paucis visibilibus pagine superiore, sepalis ca. 13–14 mm longis (vs. 8 mm), petalis ca. 16 mm longis (vs. 9 mm), carpellis fructus fusiformibus 14 × 7 mm (vs. ellipsoidis 20 × 13 mm), differt. Ab *O. coccinea* Engler, lamina membranacea, margine subintegra, sepalis ca. 13–14 mm longis (vs. 6 mm longis), petalis 16 mm longis (vs. 7 mm longis), differt. Ab *O. sipapoensi* Maguire & Steyermark, pedunculo saepe papilloso, lamina membranacea, margine sub-integra, sepalis ca. 14 mm longis (vs. 10–11 mm), petalis ca. 16 mm longis (vs. 10–11 mm longis), fructus carpellis fusiformibus (vs. ovoideis), differt.

Shrub or tree, 2–15 m tall, branches glabrous. Leaf blades membranaceous, elliptic to oblong, 23–29 × 7–9.5 cm, apex acuminate, base subcordate to obtuse, margin denticulate, principal vein salient on lower surface, lateral veins subequal and tertiary veins faintly evident on upper surface; petiole thick, 7–10 mm long. Inflorescence paniculate, terminal, 10–25 cm long, the peduncle often papillate, 14–15 mm long. Sepals 5, ovate, 13 × 5 mm; petals 5, obovate, 16 × 9 mm; stamens 10, anthers 12 mm long; style 10–11 mm long. Fruit with carpophore conical, 10–11 mm long, papillate, carpels fusiform, 14 × 7 mm.

Distribution. Southwestern Amazonas, Venezuela, in the upper Río Orinoco and Río Negro basins at 150–200 m elevation.

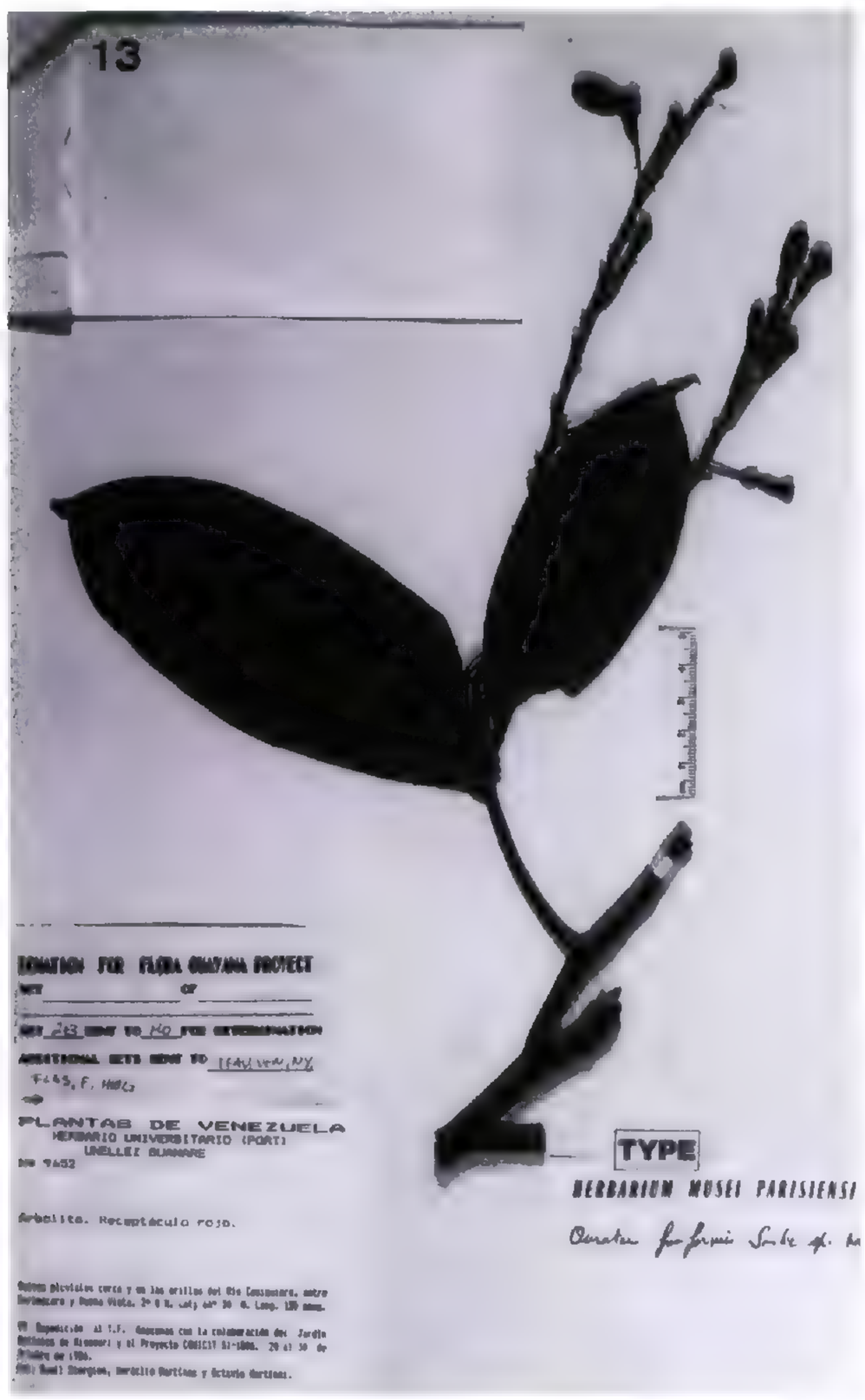
With its large leaves, *Ouratea fusiformis* is similar to *O. macrocarpa* Sastre (Fig. 14) from tall, lowland forests of the Guianas, *O. coccinea* Engler from the Amazon Basin, and *O. sipapoensis* from Cerro Sipapo in Amazonas, Venezuela, at 1450–1800 m elevation. *Ouratea fusiformis* differs, however, by its membranaceous leaves and its larger flowers, sepals 12 mm long, and petals 16 mm long (vs. respectively sepals = 8 mm, 6 mm, and 10–11 mm, petals = 9 mm, 7 mm, and 10–11 mm) and its fruiting carpels fusiform in shape (vs. ellipsoid or ovoid).

Paratypes. VENEZUELA. **Amazonas:** Dept. Río Negro, Río Yatua, 125 m, 1°30′N, 66°5′W, 13 Apr. 1970, *Steyermark & Bunting 102639* (NY, P, VEN), selva pluvial del bajo Río Yatua, 25 July 1982, *Stergios & Aymard 4141* (MO, PORT), entre la boca y la piedra Catipán, 1°25′N, 66°25′W, 1–2 Dec. 1984, *Stergios & Aymard 7486* (MO, P, PORT); Caño Tama Tama, right bank of Río Orinoco, 125 m, 13 June 1942, *Williams 15858* (US), 150 m, 23 June 1959 (fl), *Wurdack & Adderley 43144* (MO, NY, P, VEN); Río Baría, 140 m, 0°55′N, 66°16′W, 10 May 1984, *Gentry & Stein 47335* (MO, P), from Los Tambores of Comision de Limite to Caño Erubichi, 130 m, 1°02′N, 66°22′W, 2 Apr. 1984, *Liesner 17104* (MO, P), Río Mawarinuma, 1°05′N, 66°35′-45′W, 9 May 1984, *Thomas et al. 3440* (NY, P).

15. Ouratea megaphylla Sastre, sp. nov. TYPE: Venezuela. Amazonas: Dept. Atures, Puerto Ayacucho, Río Cataniapo entre la comunidad de las Pavas y Raudal Rabipelado, 6°25′N, 67°25′W, 90–100 m, 11 Apr. 1987 (fl), *A. Castillo 2341* (holotype, P; isotype, VEN). Figure 12.

Ab *Ouratea longifolia* (Lamarck) Engler, petiolo et nervi principalis base canaliculatis, lamina 35–45 cm longa (vs. 20–30 cm), inflorescentia 23–30 cm longa (vs. 5–20 cm), carpellis fructus ovoideis 10 × 5 mm (vs. meloniformibus 13–19 × 10–15 mm), differt. Ab *O. fusiformi* Sastre, petiolo et nervi principalis base canaliculatis, lamina 35–45 cm longa (vs. 23–29 cm), sepalis 10–11 mm longis (vs. 14 mm), toro fructus globoso differt.

Treelet 5–10 m tall, branches glabrous. Leaf blades coriaceous, oblong to ovate, 35–45 × 8–12.5 cm, apex acuminate, base obtuse, margin denticulate, principal vein salient on lower surface, canaliculate near the petiole on upper surface, lat-



Figures 13–16. —13. *Ouratea fusiformis* Sastre, *Stergios et al. 9652* (holotype, P). —14. *Ouratea macrocarpa* Sastre, *De Granville 44* (holotype, P). —15. *Ouratea maguirei* Sastre, *Maguire et al. 36216* (holotype, P). —16. *Ouratea rorida* Sastre, *Steyermark 89463* (holotype, P).

eral veins subequal; petiole canaliculate, ca. 1 cm long. Inflorescence paniculate, terminal, 23–30 cm long, the peduncle ca. 1 cm long, glabrous. Sepals 5, ovate, 10–11 × 2–3 mm, undulate, papillate along the principal veins on upper surface. Young petals 5, ovate, 10 × 3 mm; young stamens 10, 6 mm long, style 5 mm long. Fruit with carpophore globose, 7 mm diam., carpel ovoid, 10 × 5 mm.

Distribution. Along the Río Cataniapo in Amazonas, Venezuela, at 90–110 m elevation.

Ouratea megaphylla is similar to *O. longifolia* (Lamarck) Engler from the Lesser Antilles (Guadeloupe and Dominica) and *O. fusiformis* Sastre (Venezuela, Amazonas). *Ouratea megaphylla* is characterized by its very large leaves and its canaliculate petiole; it differs from *O. longifolia* by the size of the inflorescence (25–30 cm vs. 5–20 cm) and the form of the fruiting carpels (ovoid vs. meloniform), and from *O. fusiformis* by the size of the flower (sepals 10–11 mm long vs. 14 mm) and the form of the fruiting torus (globose vs. fusiform).

Paratypes. VENEZUELA. **Amazonas:** Dept. Atures, Puerto Ayacucho, Río Cataniapo entre Raudal Buasaujaka y comunidad de las Pavas, 6°25′N, 67°25′W, en bosque húmedo, 90–100 m, 13 Aug. 1986, *Castillo 2211* (P, VEN), desde el lugar de la futura represa hasta el caserio San Pedro de Cataniapo, 5°38′N, 67°11′W, en bosque alto denso, 90–110 m, 5 Aug. 1980 (fr), *Guanchez 111* (MO, VEN).

16. Ouratea maguirei Sastre, sp. nov. TYPE: Venezuela. Amazonas: laja on right bank of Caño Cupueru, right bank of Río Orinoco opposite mouth of Río Atabapo, 100 m, 12 Nov. 1953, *B. Maguire, J. J. Wurdack & G. S. Bunting 36216* (holotype, P; isotypes, NY, VEN). Figure 15.

Ab *Ouratea kananariensi* Sastre, lamina margine denticulata (vs. serrata), alabastris conicis (vs. globosis), sepalis 9–10 mm longis (vs. 6 mm longis), differt. Ab *O. coccinea* Engler, laminam nervis secundaris inaequalibus cum ca. 15 magnis inter nervis subparallelis tenues transversales (ca. subparallelis), sepalis 9–10 mm longis (vs. 6 mm longis), differt.

Treelet, 5 m tall, branches glabrous. Leaf blades coriaceous, (13–)22–27 × 6–8.5 cm, undulate, obovate to elliptic, apex obtuse and strongly acuminate, margin denticulate, principal vein salient on lower surface, some lateral veins ascending, impressed on upper surface and salient on lower surface, not salient between smaller veins; petiole 1 cm long. Inflorescence terminal, paniculate, 7–22 cm long, axis papillate, the first branches subtended by a 4 × 4 bifid scale. Pedicels ca. 10 mm long, not regularly papillate; sepals 5, sometimes papillate, ovate-subtriangular, 9–10 × 3–3.5 mm; petals 5, spatulate, 13–14 × 8 mm; stamens 10, 5 mm long; style 7 mm long. Fruit not seen.

Distribution. Known only from the type collection from San Fernando de Atabapo, Amazonas, Venezuela.

Ouratea maguirei is similar to *O. kananariensis* Sastre described from Río Kananari, Vaupès, Colombia, and collected by me near La Chorrera, Río Igara-Paraná, Amazonas, Colombia, and *O. coccinea* from the Amazon Basin. *Ouratea maguirei* differs from *O. kananariensis* by the denticulate (vs. serrate) margin of the leaves, the conical (vs. globose) flower buds, and larger flowers (sepals 9–10 mm long vs. 5–6 mm; petals 13–14 mm long vs. 9 mm). *Ouratea maguirei* was found growing on a granitic outcrop (laja), while *O. kananariensis* is on quartzitic outcrops and sandy soils. *Ouratea maguirei* differs from *O. coccinea* by the secondary venation of the leaves: unequal with ca. 15 paired large veins between smaller veins in *O. maguirei,* subequal in *O. coccinea.* Flowers of *O. maguirei* are bigger; the sepals are 10–11 mm long (vs. 6 mm).

17. Ouratea rorida Sastre, sp. nov. TYPE: Venezuela. Bolívar: Sierra de Lema. Cabeceras de Río Chicanán, 80 km al suroeste de El Dorado, 6°5′N, 62°W, rainforest in valley lowland, 300 m, 24 Aug. 1961 (fl), *J. A. Steyermark 89463* (holotype, P; isotypes, NY, VEN). Figure 16.

Ab *Ouratea guianensi* Aublet, nerviis lateralibus paucis prominentibus, alabastris 5 mm longis (vs. 7–8 mm), fructibus sepalis caducis, toro globoso 3–4 mm diam. (vs. lenticulari 4 mm alto, 8 mm diam.), carpellis 5–6 × 8 mm (vs. 15 × 10 mm), differt. Ab *O. microcalyce* (Engler) Sastre, foliarum epidermide rorida, nerviis lateralibus paucis prominentibus non subparallelibus, alabastris 5 mm longis (vs. 7 mm), differt.

Tree or treelet, 3–15 m tall, branches glabrous. Leaf blades membranous, 18–23 × 5.5–8.5 cm, elliptic-obovate, epidermis covered with small, transparent tubercles that have the appearance of fine drops of dew, apex acuminate, base attenuate, margin undulate, denticulate with very small black teeth, principal vein salient on lower surface, lateral veins faintly salient on both surfaces, with some arcuate-ascending between the smaller, subparallel ones; petiole 1 cm long. Bracts on the young inflorescences triangular, 2–4 × 1–2 mm, aristate. Sepals 5, ovate, 5–5.5 × 1.5–2.5 mm; petals 5, spatulate, 4.5 × 6 mm; stamen 10, tuberculate, 3.5 mm long, carpels 5, style ca. 3 mm long. Fruit torus globular, 3–4 mm diam., carpels 5–6 × 8 mm.

Figures 17, 18. —17. *Ouratea elongata* Sastre, *Henkel et al. 1001* (holotype, P). —18. *Ouratea maigualidae* Sastre, *Huber et al. 13100* (holotype, P).

Distribution. Northern Bolívar and northern Amazonas states, Venezuela.

Ouratea rorida has been confused with *Ouratea guianensis* Aublet (sect. *Ouratea*, from Maranhão, Brazil, to Delta Amacuro, Venezuela) and with *O. microcalyx* (Engler) Sastre (sect. *Caducae*) from Guyana. *Ouratea rorida* differs from the two latter species by having the secondary and tertiary nerves only slightly salient on both surfaces and by its small flowers (5 mm long vs. 7–8 mm long in *O. guianensis* and 7 mm long in *O. microcalyx*). *Ouratea rorida* has its epidermis minutely tuberculate as *O. guianensis* but its fruits do have not persistent sepals as *O. microcalyx*.

Paratypes. VENEZUELA. **Bolívar:** along Río Caura ca. 10 km SSE of Las Pavas (Salto Para), 6°11′N, 64°25′W, primary forest and river edge, 240 m, 6 May 1982, *Liesner & Morillo 13886* (VEN), 2–8 km Sur del Salto Para, bosque humedo ripariño, 10 May 1982, *Morillo & Liesner 9089* (MO, P, VEN); Medio Río Paragua, Medio Río Oris, en los alrededores del campamento Turumban, 6°21′N, 63°45′W, selvas humedas ribeñeras y de lomerio, 300 m, 13 May–13 June 1987 (fr), *Stergios 10718* (P, PORT). **Amazonas:** Dpto. Atures, 1–2 km of Río Coro-Coro, W of Serranía de Yutaje, 5°43′N, 66°07′W, forested slope, 400–550 m, 25 Feb. 1987, *Liesner & Holst 21403* (MO, P).

18. Ouratea elongata Sastre, sp. nov. TYPE: Guyana. Potaro-Siparuni Region, Pakaraima Mountains, Cipo Mountain, ca. 2 km from summit escarpment at headwater Cipo Creek, 4°54′N, 60°05′W, drainage slopes in mixed montane forest, sandstone talus, 1000 m, 27 Jan. 1993, *T. W. Henkel, M. Chin & W. Ryan 1001* (holotype, P; isotype, US). Figure 17.

Ab *Ouratea patenti* Engler, foliis petiolo 0.5 cm longo (vs. 1 cm), nervo principali non prominenti pagina inferiore, nervis lateralibus pauci visibilibus, impressis pagina inferiore, margine serrulato, differt.

Tree, 5 m tall, stems glabrous. Leaf blades coriaceous, 23–25 × 4–4.5 cm, ovate, elongate, a few falciform, apex not seen, base attenuate, margin serrulate, principal vein salient on upper surface, sunken on lower surface, some lateral veins arcuate between smaller, straight ones, all salient on upper surface, impressed on lower surface, tertiary veins not visible; petiole ca. 0.5 cm long. Flowers not

seen. Fruits with torus discoidal, 5–6.5 mm diam., 3.5–4 mm high.

Distribution. Known only from the type from Cipo Mountain, Pakaraima Mountains, Guyana.

Ouratea elongata is similar to *O. patens* Engler from the Rio Negro, Brazil, but differs by having a shorter petiole (5 mm long vs. 10 mm) and the principal nerve salient on the upper surface and sunken on the lower surface (vs. salient on both surfaces), and the margins serrulate (vs. entire).

19. Ouratea maigualidae Sastre, sp. nov. TYPE: Venezuela. Amazonas: Dept. Atures, Sierra Maigualida, sector noroccidental, en pequeño valle, afluente izquierdo del Caño Iguana medio, 5°30′N, 65°15′W, entre rocas, 2000 m, 2 Mar. 1991 (fl), *O. Huber, P. Berry & J. Rosales 13100* (holotype, P; isotype, MYF). Figure 18.

Ab *Ouratea roraimae* Engler, basi laminae cordata, nerviis lateralibus impressis, alabastris majoribus (ca. 8 mm longis vs. 5–6 mm), differt. Ab *O. sipapoensi* Maguire & Steyermark, laminis minoribus (6–9 × 4–7 cm vs. 11–14 × 5.5–9 cm), bene ovatis, base bene cordata, nerviis lateralibus impressis, petiolo ca. 3 mm longo (vs. 8–10 mm), fructus toro applanato (vs. turbinato), differt.

Shrub or treelet, 1.5–4 m tall, stems glabrous. Leaf blades coriaceous, ovate, 6–9 × 4–7 cm, base cordate, margin entire, apex somewhat acuminate or retuse, principal vein salient above, secondary veins impressed unequal, the longer arcuate between smaller straight ones, anastomosed with the faintly evident tertiary veins; petiole ca. 3 mm long. Inflorescence paniculate, terminal, 8–15 cm long. Peduncle ca. 1 cm long; sepals 5, oblong, 9 × 4 mm, persisting briefly after anthesis; petals 5, spatulate, 10 × 9 mm, stamens 10, 5 mm long; style 6 mm long. Immature fruit with torus flattened, 5 mm diam., 2 mm high.

Distribution. Known only from the Sierra Maigualida, Amazonas, Venezuela.

Ouratea maigualidae is similar to *Ouratea roraimae* Engler (from northern Amazonian Brazil, Guyana, and southern Venezuela, at 100–800 m elevation), and *O. sipapoensis* Maguire & Steyermark (from Cerro Sipapo, Amazonas, Venezuela, at 1600–1800 m elevation). *Ouratea maigualidae* differs from *O. roraimae* by having leaves with lateral nerves impressed (vs. not impressed), the base cordate (vs. obtuse), and larger flowers 8 mm long (vs. 5–6 mm); and from *O. sipapoensis* by the size of the leaves (6–9 × 4–7 cm vs. 11–14 × 5.5–9 cm), the lateral nerves impressed (vs. not impressed), a shorter petiole (3 mm long vs. 8–10 mm), and the shape of the fruiting torus (flattened vs. turbinate).

Paratypes. VENEZUELA. **Bolívar**: Dept. Atures, Sierra Maigualida, NW sector, small valley along an upper tributary of Caño Iguana, 5°30′N, 65°15′W, in low forest in depression between granitic outcrops, 2000 m, 28 Feb.–3 Mar. 1991 (fl), *Berry, Huber & Rosales 4876* (MO, P), Cabeceras del río Iguana, afluente del Río Asita, 5°43′N, 65°19′W, bosque ribereño y matorrales secundarios sobre vertiente inclinada hacia el SE, alt. 1720 m, 25 Mar. 1988 (fr), *Huber 12691* (MYF, P).

With the species described in this paper, there are now 70 species of *Ouratea* known to occur in the Venezuelan Guayana, including 47 endemic species (35 in Amazonas state and 12 in Bolívar state). Two Venezuelan Guayana endemics, *O. ramosissima* Maguire & Steyermark and *O. rorida* Sastre, are found in both Bolívar and Amazonas states. In Amazonas state, 15 of the 51 species known from there also occur in adjacent countries (Colombia, Brazil), and in Bolívar state, 14 of the 26 species known also occur in Guyana and Brazil. Both states are surrounded by biogeographical barriers: Amazonas state by the middle Río Orinoco (border with Colombia ; Sastre, 1994) on the western edge, and the Sierra de Maigualida on the eastern edge (border with Bolívar state); Bolívar state is surrounded by Sierra Maigualida and the Río Caura valley on the western edge, and the Gran Sabana (border with Guyana) on the eastern edge.

Some tepuis are veritable islands, similar to those found in the Lesser Antilles (Sastre & Lourteig, 1986) with examples of endemo-vicariance in the sense of Gaussen and Leredde (1949): in a group of related species, each summit or island has its own endemic species. Examples of this in the Guayana Shield are: *Ouratea paruensis* Maguire & Steyermark (endemic to Cerro Parú), *O. sipapoensis* Maguire & Steyermark (endemic to Cerro Sipapo), and *O. magualidae* Sastre (endemic to Sierra Magualida).

Ouratea also contains examples of geographical vicariances between neighboring countries and from the same ecological niches, for instance, *O. gillyana* (Dwyer) Sandwith & Maguire in Guyana and *O. articulata* Sastre in Bolívar, Venezuela, both from savanna and belonging to section *Kaieteurea*; *O. kananariensis* Sastre in Vaupés and Amazonas, Colombia, and *O. maguirei* Sastre in Amazonas, Venezuela, both in forest and belonging to section *Caducae* with large leaves. Ecological vicariance is demonstrated on Cerro Guaiquinima, Bolívar, Venezuela, by *O. culminicola* Maguire & Steyermark, which occurs at 730–750 m elevation, and *O. orisima* Sastre, along the Río Oris, at the base of the same mountain at 300 m elevation, both belonging to section *Caducae* with spiciform inflorescences.

Speciation due to genetic drift may be very ac-

tive in the genus, perhaps exemplified by the following species pairs: *O. lajaensis* Sastre, endemic to granitic outcrops (lajas) near Puerto Ayacucho is likely derived from the more widespread *O. polyantha* (Triana & Planchon) Engler, occurring in the Colombian and Venezuelan savannas; *O. heterobracteata* Sastre, endemic to the Río Guiania along the Venezuelan-Colombian border is perhaps derived from *O. ferruginea* Engler, a more widespread species occurring in the Amazon and Orinoco River basins.

Acknowledgments. I thank Bruce Holst for his assistance with the manuscript.

Literature Cited

Gaussen, H. & C. Leredde. 1949. Les endémiques pyrénéo-cantabriques dans la région centrale des Pyrénées. Bull. Soc. Bot. Fr. n sp. 76° session extra 1948: 57–83.

Sastre, C. 1994. Le Moyen Rio Orinoco, frontière phytogéographique? Biogeographica 70(2): 93–94.

———. 1995. Novelties in the neotropical genus *Ouratea* Aublet (Ochnaceae). Novon 5: 193–200.

——— & A. Lourteig. 1986. Endémovicariance en Amérique tropicale: Implication dans la spéciation. Bull. Ecol. 17(3): 189–194.

Croton diasii and *Croton trombetensis*, Two New Euphorbiaceae from Amazonian Brazil

Ricardo de S. Secco
Depto. de Botânica, Museu Paraense Emilio Goeldi, Cx. Postal 399, Belém-PA, Brazil

Paul E. Berry
Department of Botany, University of Wisconsin, 132 Birge Hall, 430 Lincoln Drive, Madison, Wisconsin 53706, U.S.A.

Nélson A. Rosa
Depto. de Botânica, Museu Paraense Emilio Goeldi, Cx. Postal 399, Belém-PA, Brazil

ABSTRACT. Two new species of *Croton* are described from Amazonian Brazil, *Croton diasii* and *C. trombetensis*. *Croton diasii* is superficially similar to *C. schiedeanus*, but differs in having leaves with sparse lepidote scales on the lower surface, the upper surface glabrous, a pair of glands at the base of the blade, lack of petals in the pistillate flowers, and stamens densely villous on the lower half of the filaments. *Croton trombetensis*, which lacks a close affinity to any other *Croton* from the Brazilian Amazon, is characterized by leaves with a dense indument of stellate trichomes on both sides, a cordate base, long acicular stipules, a robust terminal thyrse 40–46 cm long, staminate flowers in fasciculate cymules, and pistillate flowers mixed among the staminate ones.

RESUMO. Duas novas espécies da Amazônia Brasileira, *Croton diasii* e *C. trombetensis*, são descritas. *Croton diasii* é superficialmente semelhante a *C. schiedeanus*, mas separa-se por apresentar folhas com tricomas lepidotos esparsos na face abaxial, a face adaxial glabra, um par de glândulas na base do limbo, ausência de pétalas na flor pistilada e estames densamente vilosos até a metade do filete. *Croton trombetensis* não apresenta afinidades claras com nenhuma outra espécie da Amazônia Brasileira, e caracteriza-se pelas folhas com denso indumento de tricomas estrelados em ambas as faces, base cordada, longas estípulas aciculadas, inflorescência em tirso terminal, robusta (40–46 cm de comprimento), as flores estaminadas em fascículos e as pistiladas misturadas com as estaminadas.

Key words: Amazon, Brazil, *Croton*, Euphorbiaceae.

Croton L. is one of the largest genera of flowering plants, with upward of 1200 species, most of these distributed in the Antilles and South America (Webster, 1994; Govaerts et al., 2000). Since the treatment by Mueller (1873) in *Flora Brasiliensis*, the Brazilian species have not been revised taxonomically. Floristic and taxonomic works on *Croton* in South America, such as those of Lanjouw (1931), Croizat (1940, 1941, 1944), Jablonski (1965), Secco (1992), and Webster et al. (1999), neglected to examine a large number of specimens in Amazonian herbaria such as IAN, INPA, and MG. Consequently, the current state of understanding of Amazonian taxa of *Croton* is rather incomplete. In an attempt to revise the 40 or so species known from the Brazilian Amazon (including the states of Pará, Amapá, Amazonas, and Maranhão), we were able to recognize two additional species that are described below.

Croton diasii Pires ex R. Secco & P. E. Berry, sp. nov. TYPE: Brazil. Pará: Belém, Reserva Aurá, 15 Jan. 1968 (fl), *J. M. Pires & N. T. Silva 11377* (holotype, IAN). Figure 1.

Arbor monoecia trichomatibus lepidotis obtecta. Folia penninervia basi glandulis binis munita, subtus trichomatibus lepidotis obtecta, supra glabra. Inflorescentia in racemis unisexualibus vel bisexualibus. Flores staminati petalis anguste lanceolatis instructi; stamina usque ad dimidiam partem filamenti dense villosa. Flores pistillati sine petalis. Fructus junior castaneo-flavescens.

Tree 3–13 m tall. Leaves chartaceous or sometimes coriaceous, 7–19 × 2.5–7 cm, pinnately veined, elliptic to elliptic-oblong, the upper surface glabrous, the lower surface with readily visible lepidote trichomes, the base of the blade with a pair of glands, the apex acuminate, the base obtuse to slightly cuneate; petiole 0.5–1.5 cm long, with a ferruginous indument of scaly trichomes. Staminate

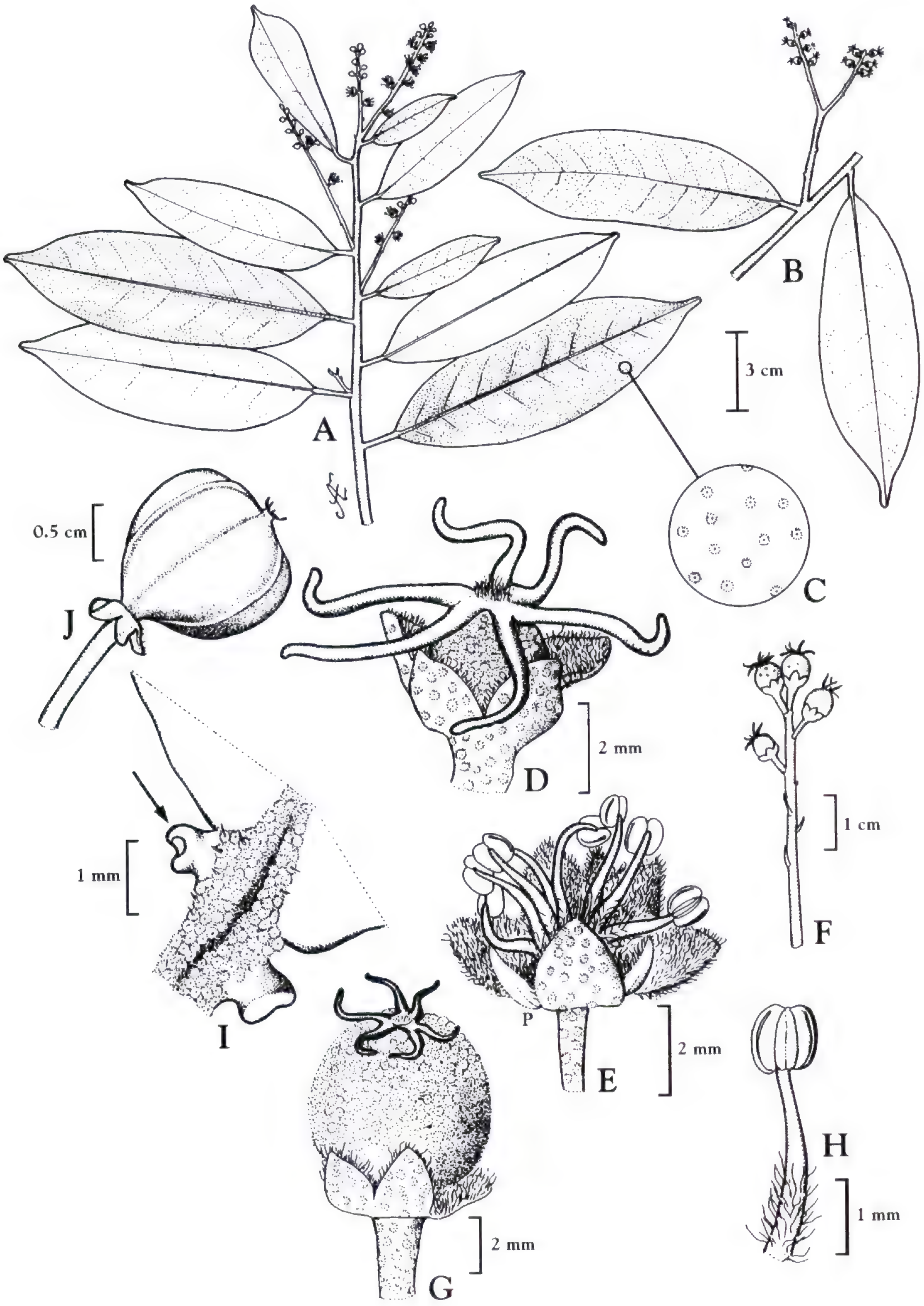


Figure 1. *Croton diasii* Pires ex R. Secco & P. E. Berry. —A. Branch with staminate inflorescences (*Pires & Silva 11162*). —B. Branch with pistillate inflorescence (*Pires & Silva 11377*). —C. Lepidote trichomes, from the abaxial side of the leaf (*Pires 14905*). —D. Pistillate flower (*Pires & Silva 11377*). —E. Staminate flower (p = petal, *Pires & Silva 11162*). —F, G. Young fruits (*Schubert 2174*). —H. Stamen with villous base of the filaments (*Pires & Silva 11162*). —I. Glands on the base of the leaf blade (*Fróes 26596*). —J. Mature fruit (*Pires 14905*).

inflorescence racemose, axillary and terminal, 3–8 cm long, the flowers single or in pairs; staminate flowers with pedicels 3–4 mm long, with lepidote trichomes, calyx 5-lobed, each lobe 2–2.5 × 1–1.5 mm, elliptic-lanceolate, with lepidote trichomes externally, villous trichomes internally; petals 4 or 5, narrowly lanceolate, 2–3 × 0.5–1 mm, glabrous externally, internally with villous trichomes and along the margins; stamens 12, filaments basally connate, 3–3.5 mm long, with villous trichomes concentrated near the base. Pistillate inflorescence an axillary or terminal raceme 4–6 cm long, occasionally geminate, the flowers single; pistillate flowers with pedicels 1–1.5 mm long, with lepidote trichomes, calyx 5-lobed, each lobe ca. 3 × 2 mm, elliptic-ovate, with lepidote trichomes externally, densely villous internally, petals lacking; ovary globose, 2–2.5 mm diam., 3-locular, with lepidote trichomes, styles 3, each branch bifid, with a tuft of trichomes at the base. Inflorescences rarely bisexual, then with staminate flowers more numerous and a few pistillate flowers near the base. Fruit subglobose, yellowish brown when young, 1.2–1.4 cm diam., with lepidote trichomes, the calyx persistent, mericarps 3. Seeds not seen.

Croton diasii superficially resembles *C. schiedeanus* Schlectendahl, but it can be distinguished by the following characters: leaves with scattered and readily visible lepidote trichomes on the lower leaf surface, the upper surface glabrous; a pair of glands at the base of the leaf blade; staminate flowers narrowly lanceolate; stamens densely villous in the lower half of the filament; lack of petals in the pistillate flowers; and young fruit yellowish brown. The geographic distribution of *Croton diasii* is restricted to the Brazilian state of Pará, whereas *C. schiedeanus* is much more broadly distributed, occurring in Mexico and Central America, Colombia, Venezuela, the Guianas, Ecuador, Peru, and recently recorded from Pará in Brazil.

Based on the presence of lepidote trichomes, entire and pinnately veined leaves with a pair of basal glands, stamens 12, pedicellate pistillate flowers, entire and eglandular sepals, and bifid styles, *Croton diasii* belongs to section *Argyrocroton* (Mueller Argoviensis) G. L. Webster, following the system proposed by Webster (1993).

The specific epithet honors Domiciano Dias, a renowned Brazilian entomologist and friend of Murça Pires.

Paratypes. BRAZIL. **Pará:** Belém, IPEAN, Reserva APEG, 28 ago. 1967 (fl), *J. M. Pires & N. T. Silva 11162* (IAN); Fazenda Aurá, mata terra firme, 30 set. 1950 (fl), *R. L. Fróes 26596* (IAN); rio Guamá, APEG, dez. 1965 (fl, fr), *B. G. Schubert 2174* (IAN); IPEAN, várzea do Aurá, 18 out. 1974 (fr), *J. M. Pires 14905* (IAN); Belém, terra firme, 13 jan. 1953 (fl, fr), *J. M. Pires & N. T. Silva 4438* (IAN).

Croton trombetensis R. Secco, P. E. Berry & N. A. Rosa, sp. nov. TYPE: Brazil. Pará: município de Porto Trombetas, 1 Jan. 1998 (fl, fr), *R. P. Salomão & N. A. Rosa 880* (holotype, MG; isotypes, IAN, INPA, NY). Figure 2.

Arbor monoecia trichomatibus stellatis obtecta. Folia palmatinervia basi cordata, 2–3 glandulis laminae basi affixis, stipulae longae, aciculatae, subtus glandulis stipitatis instructa. Inflorescentia in racemis terminalibus robustis disposita; flores in fasciculis dispositi, pistillati cum pluribus floribus staminatis mixti. Flores staminati staminibus glabris in caespitibus trichomatum villosorum affixis. Flores pistillati petalis valde angustis inter se disiunctis. Fructus pulverulentus indumento dense stellato obtectus.

Tree to 15 m tall and 60 cm diam. (DBH). Leaves chartaceous, rarely subcoriaceous, 14–30 × 10–16 cm, palmately nerved, with a dense indument of stellate trichomes on both sides, the upper surface velutinous to the touch, the lower surface asperous, 2 or 3 glands at the base of the blade and stipitate glands sparsely distributed over the lower surface, margins dentate and glandular-stipitate in the sinuses, the apex caudate, the base cordate; petioles 10–24 cm long, with a dense indument of long, stellate trichomes; stipules acicular, 1–1.3 cm long. Inflorescence a terminal, racemoid thyrse 40–60 cm long, the rachis with densely stellate indument, the flowers grouped in fasciculate cymules, the staminate ones more numerous and grouped with the pistillate ones. Staminate flowers with a slender pedicel 0.8–1.0 cm long, with stellate trichomes, the calyx 5-lobed, each lobe 2.5–3 mm wide, ovate-elliptic, with stellate trichomes externally, glabrous internally, villous along the margins; petals 5, narrowly lanceolate, 3 mm long, 1 mm wide, glabrous externally, villous internally, stamens 16, the filaments glabrous, 5–6 mm long, emerging from a tuft of villous trichomes. Pistillate flowers with a thick pedicel 3–4 mm long, the calyx 5-lobed, each lobe 1.5–2 mm long, ovate, with a dense indument of stellate trichomes externally, internally with sparse stellate and simple trichomes, petals 5 or 6, narrow, well separated from each other, 1.5–2 mm long, glabrous externally, with villous trichomes internally and along the margins; ovary subglobose, 4 mm diam., with a dense indument of stellate trichomes, a segmented nectary disk at the base, styles 3, bifid, branches 7–8 mm long, sparsely stellate. Fruit with dense-stellate indument, ca. 1

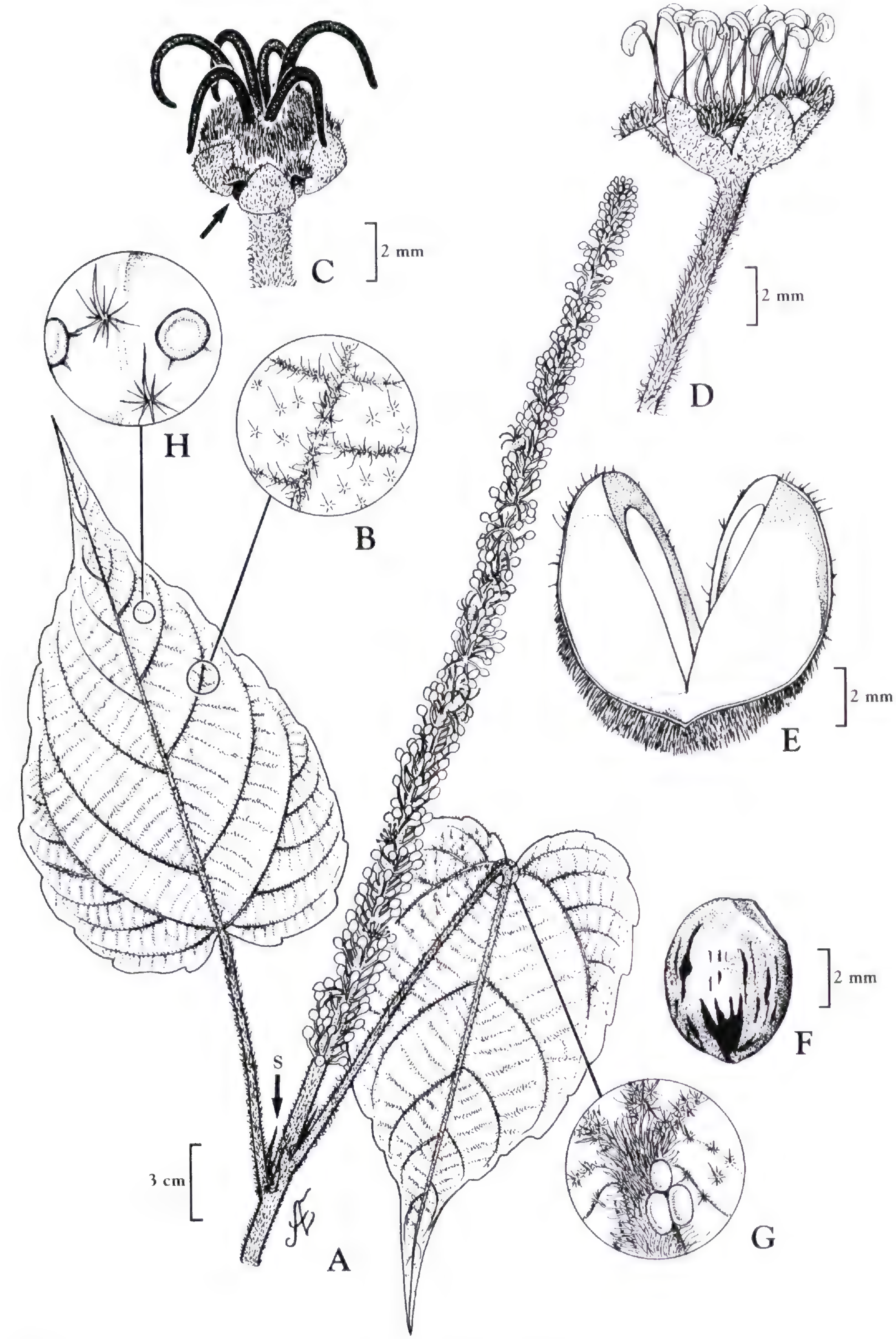


Figure 2. *Croton trombetensis* R. Secco, P. E. Berry & N. A. Rosa. —A. Branch with bisexual inflorescence (s = stipule). —B. Stellate trichomes from the lower surface of the leaf. —C. Pistillate flower (arrow points to one of the petals). —D. Staminate flower. —E. Mericarp opening in two parts. —F. Seed, showing poorly developed caruncle near the micropyle. —G. Glands at the base of the leaf blade. —H. Stipitate glands on the lower leaf surface. (All from *Salomão & Rosa 880.*)

cm diam., mericarps 3, seeds mottled, 6–7 mm long, barely carunculate.

According to the sectional delimitations of *Croton* proposed by Webster (1993), *C. trombetensis* belongs to section *Cyclostigma* Grisebach subsection *Cyclostigma*, based on the presence of palmately veined leaves with dentate margins, a dense indument of stellate trichomes, glands at the base of the leaf blade, terminal inflorescences with bisexual basal cymes, staminate flowers with 16 stamens, and pistillate flowers with petals and bifid styles. The species is further characterized by its arborescent habit, basally cordate leaves, long acicular stipules, stipitate glands on the lower leaf surface and the base of the blade, and very long racemes. The local common name of this species in Pará is "pau-de-índio," and it appears to lack close morphological similarities to any other species of *Croton* from Amazonian Brazil.

Acknowledgments. The senior author thanks the Brazilian CNPq for their financial support of this work (Project N° 301.252–86–6). Two members of the Departamento de Botânica–MPEG helped us collect specimens, Ima Vieira for *Croton diasii*, and Raphael P. Salomão for *C. trombetensis*, with the support of the company Mineração Rio do Norte. William A. Rodrigues, from the Universidade Federal do Paraná, Brazil, helped us with the Latin diagnosis. We also thank two student assistants supported by CNPq–PCI, Eliélson Rocha for the drawings, and Ione Bemerguy for typing the text.

Literature Cited

Croizat, L. 1940. Thirty-five new species of American *Croton*. J. Arnold Arbor. 21: 76–107.

———. 1941. Preliminaries for the study of Argentine and Uruguayan species of *Croton*. Darwiniana 5: 417–462.

———. 1944. Additions to the genus *Croton* L. in South America. Darwiniana 6: 442–468.

Govaerts, R., D. G. Frodin & A. Radcliffe-Smith. 2000. World Checklist of Euphorbiaceae (and Pandaceae). Vol. 2. Euphorbiaceae: *Croton* to *Excoecariopsis*. Royal Botanic Gardens, Kew.

Jablonski, E. 1965. Euphorbiaceae. *In:* B. Maguire & Collaborators, Botany of the Guayana Highland, Part VI, Mem. New York Bot. Gard. 12(3): 150–178.

Lanjouw, J. 1931. The Euphorbiaceae of Surinam. J. H. de Bussy, Amsterdam.

Mueller, J. 1873. Euphorbiaceae: *Croton*. *In:* C. F. P. Martius & A. G. Eichler (editors), Flora Brasiliensis 11(2): 82–273.

Secco, R. S. 1992. Notas sobre as lianas do gênero *Croton* L. (Euphorbiaceae). Bol. Mus. Para. Emilio Goeldi, sér. Bot. 8(2): 265–281.

Webster, G. L. 1993. A provisional synopsis of the sections of the genus *Croton* (Euphorbiaceae). Taxon 42: 793–823.

———. 1994. Synopsis of the genera and suprageneric taxa of Euphorbiaceae. Ann. Missouri Bot. Gard. 81: 33–144.

———, P. E. Berry, W. S. Ambruster, H-J. Esser, L. J. Gillespie, W. J. Hayden, G. A. Levin, R. S. Secco & S. V. Heald. 1999. Euphorbiaceae. *In:* P. E. Berry, K. Yatskievych & B. K. Holst (editors), Flora of the Venezuelan Guayana 5: 72–228. Missouri Botanical Garden Press, St. Louis.

Rubiacearum Americanarum Magna Hama Pars I.[1] A New Species of *Chomelia* from Panama

David H. Lorence
National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Kauai, Hawaii 96741, U.S.A. lorence@ntbg.org

Charlotte M. Taylor
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.
charlotte.taylor@mobot.org

ABSTRACT. The new species *Chomelia rubra* Lorence & C. M. Taylor, described and illustrated here, is known only from central Panama. This new species has red to pink flowers that are sessile and solitary or few in subsessile short cymules. This new species has previously been confused with *C. recordii* Standley.

RESUMEN. La especie nueva *Chomelia rubra* Lorence & C. M. Taylor, aquí descrita e ilustrada, está registrada solamente de Panamá central. Esta especie nueva tiene flores rojas a rosadas, y sésiles y solitarias o pocas en címulas corta subsésiles. Anteriormente esta especie nueva ha sido confundida con *Ch. recordii* Standley.

Key words: *Chomelia*, Mesoamerica, Panama, Rubiaceae.

During study of recent Rubiaceae collections for the *Flora Mesoamericana*, a number of undescribed species have been discovered, and taxonomic changes for other species have become indicated. This article is the first of a series presenting this new information in detail, beyond that allowed by the synoptic format of the *Flora Mesoamericana*.

Chomelia Jacquin (Guettardeae) comprises about 50 (Steyermark, 1974) to 76 (Andersson, 1992) species found in the Neotropics, from central Mexico to Paraguay. This genus is characterized by axillary inflorescences, a four-lobed to rarely truncate (e.g., *C. microloba* Donnell Smith) calyx, tubular to salverform corollas with four valvate or valvate-induplicate lobes, four stamens, and drupaceous fruits with a single 2- to 3-celled pyrene. Some species have leaves with distinctive closely lineolate (i.e., closely set and parallel) tertiary leaf venation and scorpioid cymes. *Anisomeris* C. Presl was formerly separated from *Chomelia* based on its valvate-induplicate corolla lobes with the margins crisped and sometimes also appendaged, but careful study of this feature disclosed that it shows continuous variation and sometimes varies within a single species; therefore these two genera are better combined (Steyermark, 1967). The neotropical genus *Chomelia* Jacquin should not be confused with *Chomelia* L., which is a synonym of the wholly paleotropical genus *Tarenna* Gaertner (Pavetteae).

Chomelia rubra Lorence & C. M. Taylor, sp. nov. TYPE: Panama. Colón: Santa Rita camino a zona maderera, 10 Oct. 1968, *M. D. Correa A. & R. L. Dressler 1092* (holotype, PMA; isotypes, DUKE-265877, MO-2393591). Figure 1.

Haec species *Chomelia recordii* Standley similis, sed ab ea lobulis calycinis 1–2 mm longis atque corollae rubrae vel roseae extus strigulosae lobulis ca. 2.5 mm longis obtusis vel rotundatis distinguitur.

Shrubs, treelets, or trees to 4 m tall, unarmed; branchlets strigulose to glabrescent. *Leaves* ovate to elliptic-ovate, 2.2–11 × 1.2–6 cm, chartaceous to subcoriaceous, adaxially glabrous, abaxially hirtellous to glabrescent, at base rounded to truncate or cordulate, at apex acute to somewhat acuminate with the acumen ultimately acute and apiculate; costa plane to prominulous adaxially, prominulous to prominent abaxially; secondary veins 3 to 7 pairs, eucamptrodromous to brochidodromous, in axils with foveolate ("crypt type") domatia, the axils and/or the domatia glabrous or usually pilosulous; minor venation not or weakly visible and apparently not lineolate; *petioles* 1–4 mm long; *stipules* persistent or caducous, triangular, 2–3.5 mm long, acute to acuminate, externally strigulose. *Flowers* axillary (i.e., produced with the leaves) and/or ramular (i.e., produced on stems below the leaves), 1 to 5, sessile

[1] "A Big Bucket of American Rubiaceae," of which the present contribution contains the first few drops.

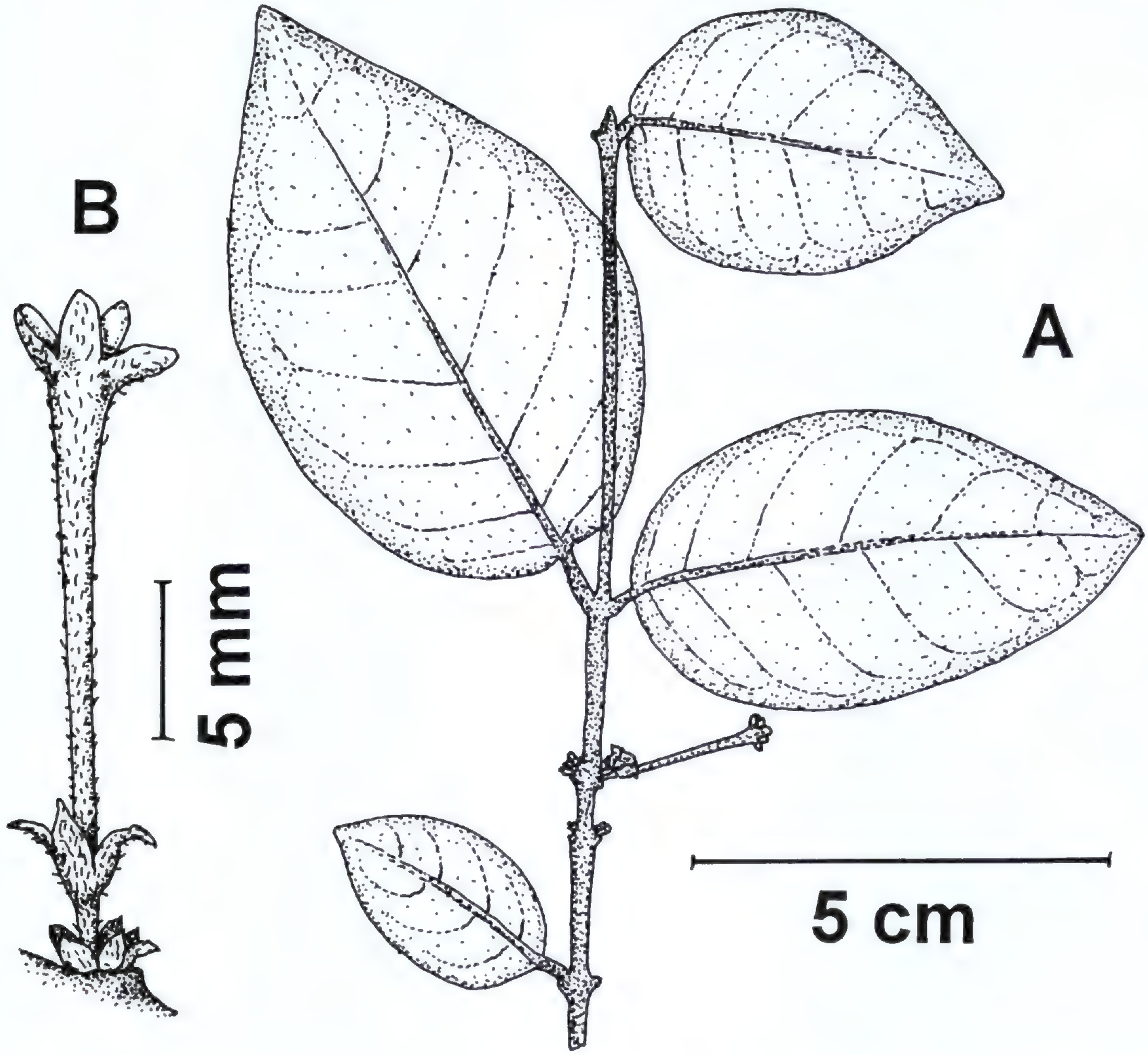


Figure 1. *Chomelia rubra* Lorence & C. M. Taylor; based on *Correa & Dressler 1092.*—A. Flowering stem. —B. Inflorescence with flower.

and solitary or subsessile in a congested cymule, this cymule sessile to subsessile; bracts triangular to linear, 0.1–0.8 mm long, acute, strigulose; hypanthium turbinate, ca. 1 mm long, densely strigulose; *calyx* limb externally strigulose, with tube 0.5–1 mm long, lobes 4, linear to triangular, 1–2 mm long and sometimes unequal on an individual flower, acute; *corolla* in bud clavate, at anthesis tubular, red to pink, externally strigulose except glabrous on margins of lobes, with tube 15–16 mm long, lobes 4, elliptic, ca. 2.5 mm long, obtuse to rounded, entire; anthers 4, ca. 2.5 mm long, partially exserted; stigmas oblong, ca. 1 mm long, situated ca. ¾ the length of the corolla tube above its base. Fruits oblong, ca. 15 × 6 mm, slightly flattened laterally, glabrescent; pyrenes smooth, 2-celled.

Habitat, distribution, and phenology. Moist forests at 300–500 m in central Panama; collected with flowers in June and October, with fruits in January.

This new species is similar in general aspect and many details to *Chomelia recordii,* and these have previously been confused. *Chomelia recordii,* however, has leaves that are apically acuminate with the acumen ultimately rounded to obtuse, flowers that are solitary or paired and terminal or axillary, hypanthium 1.5–2 mm long, calyx limb with the tube 1–3 mm long and the lobes 2–4 mm long, corolla white to cream and externally pilose to sericeous, corolla lobes 4–5 mm long and acute, and fruits 7–10 × 4–5 mm and strigulose to hirtellous. The specific epithet refers to the color of the flowers of this new species, which is unusual in *Chomelia.*

Paratypes. PANAMA. **Coclé:** Coclecito Road, elevational transect from 1 mi. beyond the divide to the ridge

top, 8°42′N, 80°28′W, *de Nevers et al. 6759* (MO). **Colón:** Santa Rita lumber road, ca. 15 km E of Colón, *Dressler & Correa 3727* (MO); Santa Rita lumber road, 8.7 km E of Transisthmia Highway, *Folsom 3696* (MO).

Acknowledgments. We thank the curators of DUKE, F, and PMA for access to specimens and information, and in particular Mireya Correa; Roy E. Gereau for preparation of the Latin diagnosis; two anonymous reviewers for constructive comments on the manuscript; and Robin Foster and the Field Museum of Natural History for support for travel by the second author to consult that collection.

Literature Cited

Andersson, L. 1992. A provisional checklist of neotropical Rubiaceae. Scripta Bot. Belg. 1: 1–199.

Steyermark, J. A. 1967. *Chomelia. In:* B. M. Maguire & Collaborators, The Botany of the Guayana Highlands. Mem. New York Bot. Gard. 17(1): 333–341.

———. 1974. Rubiaceae. *In:* T. Lasser (editor), Flora de Venezuela 9: 1–2070. Instituto Botánico, Dirección de Recursos Naturales Renovables, Ministerio de Agricultura y Cría. Caracas, Venezuela.

Rubiacearum Americanarum Magna Hama Pars II. New and Newly Circumscribed Taxa of *Guettarda* (Guettardeae)

Charlotte M. Taylor
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.
charlotte.taylor@mobot.org

David H. Lorence
National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Kauai, Hawaii 96741, U.S.A. lorence@ntbg.org

ABSTRACT. The new species *Guettarda davidseorum* Lorence and *G. subcapitata* C. M. Taylor, here described and illustrated, are known from a moist forest region in Belize and dry forest regions from southern Mexico to Nicaragua, respectively. *Guettarda davidseorum* is similar in aspect to *G. deamii* Standley, and *G. subcapitata* has been previously confused with *G. macrosperma* Donnell Smith. Also considered here are distinctive patterns of variation in the wide-ranging variable species *G. crispiflora* Vahl, which support the recognition of five subspecies with generally allopatric geographic distributions; several of these subspecies differ from those that have been previously circumscribed.

RESUMEN. Las especies nuevas *Guettarda davidseorum* Lorence y *G. subcapitata* C. M. Taylor, aquí descritas e ilustradas, han sido registradas de bosques húmedos en Belice y de bosques secos del sur de México a Nicaragua, respectivamente. *Guettarda davidseorum* es similar en su aspecto a *G. deamii* Standley, y *G. subcapitata* se ha confundido con *G. macrosperma* Donnell Smith. Además se consideran aquí los patrones de variación en la pubescencia de la especie *G. crispiflora* Vahl, que es variable y de amplia distribución; estos patrones distintivos justifican la delimitación de cinco subespecies con distribuciones geográficas generalmente alopátricas, y varias de estas subespecies difieren de las que se han delimitado previamente.

Key words: Belize, *Guettarda*, Guettardeae, Mesoamerica, Mexico, Nicaragua, Rubiaceae.

Guettarda L. (Guettardeae) comprises about 80 (Steyermark, 1974) to more than 140 (cf. Andersson, 1992) species found in the Neotropics, Asia, Madagascar, and the Mascarenes. This genus is characterized by its axillary inflorescences, calyx limbs that are truncate or irregularly to regularly 2- to 9-lobed or -denticulate, salverform to tubular corollas with 4 to 9 quincuncial lobes that are sometimes crisped to appendaged on the margins, 4 to 9 stamens, and drupaceous fruits with a single 2- to 9-celled pyrene. Some species have distinctive sublineolate (i.e., closely set and subparallel) tertiary leaf venation and/or scorpioid cymes, and the flowers are frequently distylous. The neotropical members of this genus have not been treated taxonomically together in this century, but Steyermark (1972) reviewed the genus in detail for northeastern South America and also presented a partial taxonomic treatment for some species found in adjacent regions.

During study of *Guettarda* for the *Flora Mesoamericana*, the following new species were discovered. Also, review of recently collected specimens showed that Steyermark's (1972) delimitation of the common species *G. crispiflora* Vahl and its infraspecific taxa is in need of reconsideration.

NEW SPECIES OF *GUETTARDA*

Guettarda davidseorum Lorence, sp. nov. TYPE: Belize. Toledo: Southern Maya Mountains, Bladen Nature Reserve, mountains 1.7 airline km N of the Ek Xux archeological site, 16°31′05″N, 88°54′11″W, 450 m, 24 May 1996 (fl), *G. Davidse 36271* (holotype, MO-5174713; isotypes, BM, MEXU, PTBG). Figure 1.

Haec species *Guettardae deamii* Standley affinis, sed ab ea pubescentia strigillosa, lamina foliari minore 1.5–4.5 × 0.7–1.8 cm, inflorescentia 1–3-flora pedunculo sericeo 1.5–3 mm longo insidente atque lobulis corollinis minoribus 1.5–2 mm longis differt.

Slender shrubs to 3 m tall; leafy twigs 0.7–1 mm diam., densely strigillose with ascending fulvous trichomes, soon glabrescent and becoming blackish brown. *Leaves* opposite but crowded at ends of twigs, mostly isophyllous, (1)1.5–4.5 × (0.5)0.7–

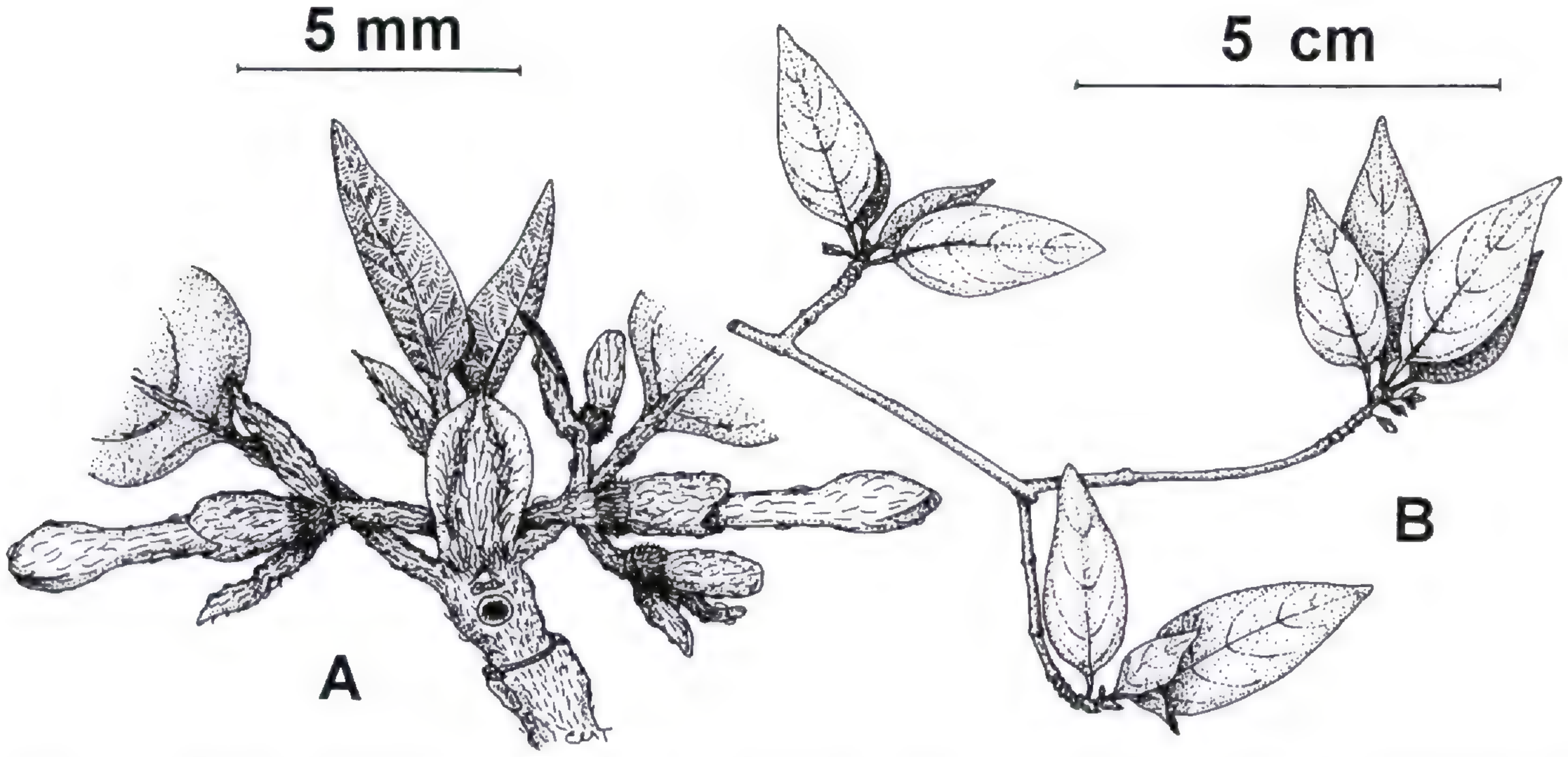


Figure 1. *Guettarda davidseorum* Lorence; based on *Davidse et al. 36271*.—A. Stem apex showing inflorescences with unopened flower buds. —B. Flowering branch.

1.8 cm, ovate to ovate-elliptic or ovate-lanceolate, drying chartaceous and discolorous, adaxially sparsely strigillose with the pubescence denser on the costa and secondary veins, abaxially densely pale brown- or fulvous-sericeous with silky trichomes concealing the surface, at base cuneate to rounded or sometimes subtruncate, at apex acute to short-acuminate; secondary veins 4 to 6 pairs, looping to interconnect, the tertiary veins subparallel, the quaternary veins reticulated within the tertiary areoles, adaxially the venation prominulous, abaxially the costa prominent, the secondary veins prominulous, and the minor venation apparently plane; *petioles* (1)2–7 × 0.3–0.4 mm, densely strigillose; *stipules* interpetiolar, 2.5–4.5 × 1–2 mm, obovate-elliptic to oblong-lanceolate, obtuse, mucronulate, externally strigillose, internally glabrous, caducous. *Inflorescences* 1 per axil, densely sericeous, with flowers solitary or 2 to 3 in a cyme to 1 cm long (including corollas); peduncles 1.5–3 mm long. *Flowers* sessile or with pedicels to 1 mm long, the lateral flowers when present subtended by 1 to 3 bracteoles 2–3 mm long, linear-oblong; hypanthium 0.5–0.7 mm long; calyx limb 1.5–2 mm long, tubular-spathaceous, split along one side or shallowly 2-lobed, externally sericeous, internally glabrous; corolla salverform, white, externally antrorse strigillose-sericeous, tube ca. 6 mm long, ca. 0.6 mm diam. near middle, lobes 4, 1.5–2 × 0.5–0.8 mm, elliptic to oblong; stamens inserted ca. 0.5 mm below top of tube, anthers ca. 1 mm long, partially exserted; style ca. 3 mm long, stigma capitate, included. *Fruits* unknown.

Distribution, habitat, and phenology. In lowland, moist, tall forest at 450 m in a saddle between volcanic- and limestone-derived mountains in southwestern Belize; collected in flower in May.

This new species is known only from the type collection. It is distinguished from other Mesoamerican *Guettarda* species by its smaller inflorescences with very short peduncles and corollas with small lobes. It is similar in general aspect to *Guettarda deamii*; *G. deamii* differs by its spreading pilose pubescence, larger leaves (4–8 × 2.5–6.5 cm) with more numerous secondary veins (8 to 10 pairs), 3- to 5-flowered inflorescences with longer pilose peduncles (3–10 mm long), and larger corolla lobes (3–4 mm long). I take pleasure in naming this new species for its collector, Gerrit Davidse, coordinator of the *Flora Mesoamericana* project, and his wife and collaborator Jeany Davidse, in recognition of their extensive contributions to neotropical botany.

Guettarda subcapitata C. M. Taylor, sp. nov. TYPE: Mexico. Chiapas: Km 18–22 de la carretera Tuxtla Gutiérrez–Cañón del Sumidero, 10 Apr. 1983 (fl), *O. Tellez & J. S. Villaseñor 6689* (holotype, MEXU; isotype, MO-3331819). Figure 2.

Haec species a congeneris limbo foliari subtus pubescentia secus costam etiam nervae secundarios patente ceterum adpressa vestito, inflorescentiis pedunculatis congesto-cymosis vel subcapitatis et foliis juvenilibus simultaneis, corollae tubo 9–13 mm longo ac lobulis 4–6 atque fructu 10–14 mm longo distinguitur.

Shrubs or trees to 7 m tall, apparently deciduous; branchlets densely strigulose to velutinous. *Leaves*

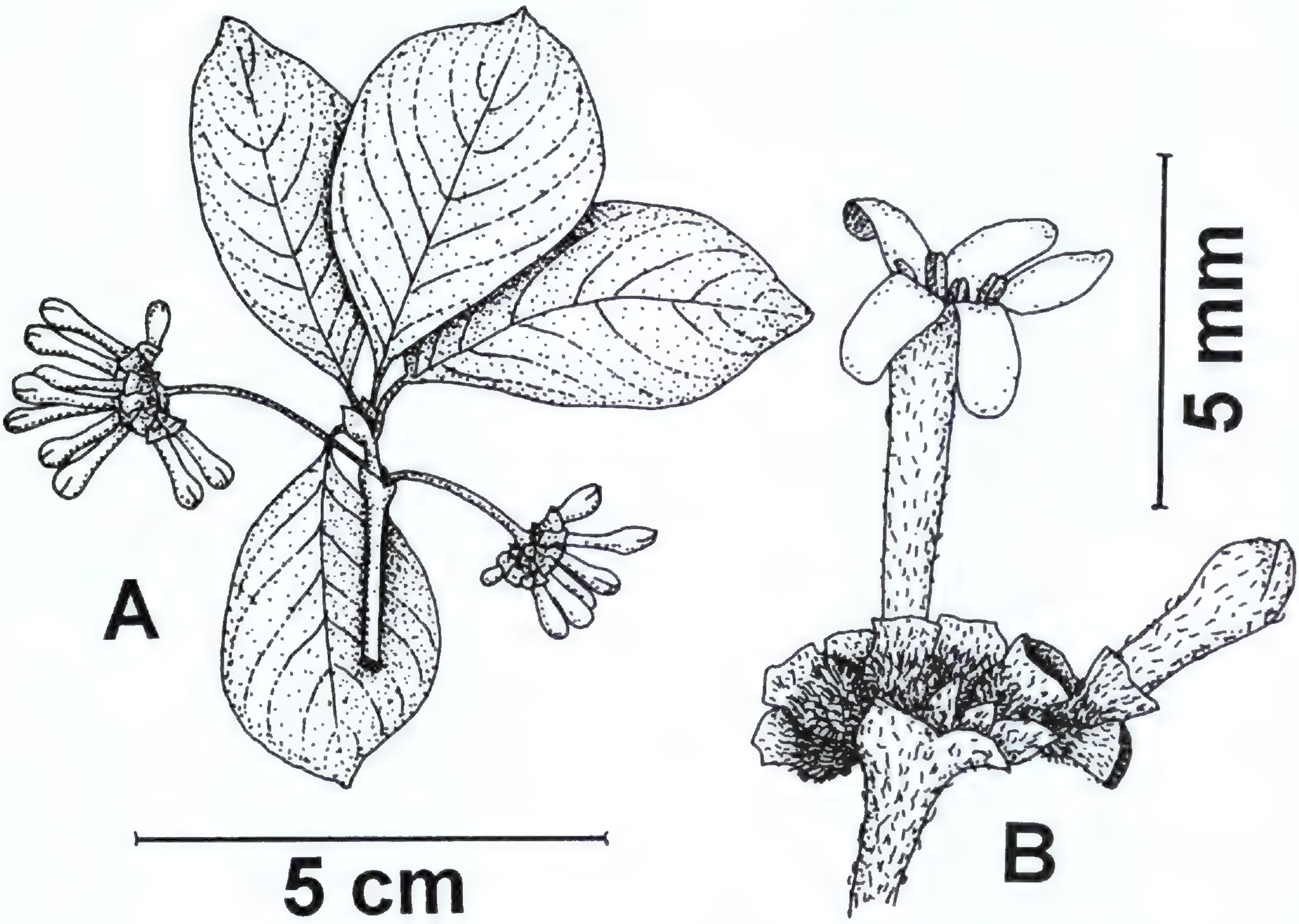


Figure 2. *Guettarda subcapitata* C. M. Taylor; based on *Téllez & Villaseñor 6609*.—A. Flowering branch. —B. Detail of inflorescence with 7 to 11 flowers, showing 1 unopened flower bud, 1 open flower, and 6 old flowers from which the corolla has fallen.

elliptic to elliptic-oblong or lanceolate, 2–10 × 1.3–7 cm, papyraceous, adaxially sparsely to moderately pilosulous to hirtellous, abaxially hirtellous on costa and secondary veins and strigulose to pilosulous on minor venation but glabrous on blade surface, at base cuneate to obtuse, at apex obtuse to acute or rarely subrounded; secondary veins 5–7 pairs, loosely looping to interconnect, with barbate domatia in axils, tertiary veins subparallel to areolate, quaternary veins reticulated inside tertiary areoles, adaxially venation plane, abaxially costa and secondary veins prominulous and remaining venation plane; *petioles* 5–12 mm long; *stipules* interpetiolar, caducous or sometimes persistent with leaves, triangular, 3–7 mm long, acute to acuminate, externally densely strigulose to sericeous. *Inflorescences* 1 per axil, subcapitate to congested cymose and shortly dichotomous, 7- to 11-flowered; peduncle 0.9–3.5 cm long; bracts none or few, narrowly ligulate, 1–9 mm long, obtuse to rounded. *Flowers* sessile; hypanthium turbinate to cylindrical, 1.5–2 mm long, densely velutinous; calyx limb 1–2.5 mm long, densely hirtellous-velutinous, truncate to shortly and irregularly 2- to 4-lobed; corolla salverform, white, externally antrorse-strigulose to -velutinous, tube 9–13 mm long, lobes (4)5(6), oblong-elliptic, 3.5–5 mm long, obtuse to rounded, plane or a little crisped; anthers ca. 3 mm long, partially exserted; stigmas capitate, ca. 0.3 mm long, situated near middle of corolla tube. *Fruits* subglobose, 10–14 mm diam., densely short-velutinous, with an apical calyx limb scar to 6 mm diam.; pyrenes smooth, 4-locular.

Distribution, habitat, and phenology. Deciduous and semideciduous dry forests and seasonal evergreen forests at 30–1350 m, southern Mexico to central Nicaragua; collected with flowers March–June, in fruit January and July–November.

This new species has been confused with *Guettarda gaumeri* Standley and *G. macrosperma*; *G. subcapitata* can be distinguished from both of these by its apparently deciduous habit, leaves with the pubescence on the abaxial surface mostly appressed except spreading on the costa and secondary veins, inflorescences that are produced together with the flush of new leaves and are congested-cymose to subcapitate, peduncles 0.9–3.5 cm long, corolla tubes 9–13 mm long, corolla lobes 4 to 6 (but usually 5), and fruits 10–14 mm diam. In con-

trast, *G. gaumeri* has inflorescences produced when the leaves are already fully developed, appressed pubescence on the abaxial leaf surface, peduncles absent or up to 8 mm long, corolla tubes 6–8 mm long, and fruits 5–7 mm long; and *G. macrosperma* has inflorescences also produced when the leaves are already fully developed, leaves with the abaxial surface glabrous except with appressed-strigillose pubescence on the costa and secondary veins, inflorescences that are congested to rather expanded cymose with the axes evident, and fruits 18–20 mm diam. The specific epithet refers to the distinctive inflorescence arrangement. In all the flowers studied the anther position, style length, and stigma position are similar to those of short-styled flowers of other species of *Guettarda*, so it is possible that *G. subcapitata* is also distylous.

Paratypes. EL SALVADOR. **La Libertad:** Chiltiupan, *Allen & Armour 7329* (F); Deninger, *Current 3* (MO); cantón El Platanillo, Quezaltepeque, *Villacorta 1082* (LAGU, MO). **Santa Ana:** municipio de Santa Ana, faldas del Cerro Las Mesas, ca. 10 km al NO de la ciudad de Santa Ana, 14°02′30″N, 89°36′W, *Linares & Martínez 2625* (MO); El Pinalito, Santa Ana, *Villacorta 2206* (LAGU, MO). GUATEMALA. **Escuintla:** La Trinidad, on road between Escuintla and Finca Zapote, *Standley 64825* (F). **Jutiapa:** 7 km NE of Jutiapa on CA-1, *Harmon & Dwyer 3339* (MO). **Sacatepeque:** 2.3 mi. SW of Alotenango on road from Antigua to Escuintla, *Croat 42013* (MO). **Santa Rosa:** near Cerro Redondo, *Standley 60413A* (F). HONDURAS. **Comayagua:** Las Limas, *Edwards P604* (F); vicinity of Siguatepeque, *Standley & Chacón 6794* (F). **Francisco Morazán:** Tegucigalpa, alrededores aldea Suyapa, quebrada La Barranca, *E. Romero 62* (MO). **Ocotepeque:** Lempa River, road to Esquipulas, *Molina 22432* (F); along Lempa River between Santa Anita and Santa Fé, *A. Molina R. & A. R. Molina 31051* (MO). MEXICO. **Chiapas:** municipio de Berriozábal, 5 km E of Berriozábal along Mexican Highway 190, *Breedlove 20374* (F, MO); municipio de Tuxtla Gutiérrez, El Sumidero, 22 km N of Tuxtla Gutiérrez, *Breedlove & Smith 21594* (F); municipio de Chiapa de Corzo, at Río Grijalva, 10 km W of Chiapa de Corzo, along Mexican Highway 190, *Breedlove 26239* (MO); municipio de Berriozábal, on flats near Berriozábal, *Breedlove 50630* (MO); El Aguacero, 13 km al NO de Ocozocoautla, *E. Cabrera & H. de Cabrera 7883* (MEXU, MO); municipio de Amatenango de la Frontera, El Sabinalito, a 14 km al SO de Motozintla, camino a Amatenango, 15°25′N, 92°07′30W, *E. Martínez S. et al. 22383* (PTBG); municipio de Ocozocuautla, canyon on Rio de la Venta at Cascada El Aguacero, 16°46′N, 93°33′W, *Neill 5566* (MO); municipio de Chiapa de Corzo, El Correadero, 5.6 mi. SE of Chiapa de Corzo, along Mexican Highway 190, *A. Shilom Ton 2962* (F). NICARAGUA. **Estelí:** Llano Redondo, *Laguna 363* (MO); along Estanzuela Creek, 8 km W of Estelí, *A. Molina R. 23081* (F); Paso León, 4 km al NE de la ciudad de Estelí, 13°7′N, 86°20′W, *Moreno 24158* (MO); La Estanzuela, 6 km al S de la ciudad de Estelí, 13°1′N, 86°21′W, *Moreno 24174* (MO); El Porvenir, 7 km al N de la ciudad de Estelí, 13°9′N, 86°22′W, *Moreno 24193* (MO). **Jinotega:** along Tuma Lake N of Jinotega, *Williams et al. 27499* (F).

The "*Guettarda crispiflora*" Complex

Steyermark (1971, 1972) was the first taxonomist to formally note that a distinctive group of commonly collected, widely distributed, and frequently confused *Guettarda* species actually comprise a single widespread species whose reproductive characters are remarkably consistent throughout its range. Based on careful study of specimens from across northern South America and the Antilles, he included a number of poorly characterized names as synonyms of *Guettarda crispiflora* Vahl, which is based on a type from Montserrat. These plants are handsome, small to medium-sized trees that are frequently encountered in flower in secondary vegetation in wet forest zones, typically at middle to higher elevations but also to as low as sea level in particularly wet zones. The inflorescences are markedly scorpioid and typically spreading to pendulous so they are visible below the leaves. The flowers are showy, sweetly fragrant, and distylous, with the corollas pale to dark pink with crisped lobes. The ripe fruits are succulent and blue-black to black.

Steyermark's broad circumscription of *G. crispiflora* comprised two subspecies and four varieties, all based on morphological details that were correlated with geographic range. In this work Steyermark focused on the plants of northeastern South America, but he also considered the plants of adjacent regions. In his classification, *G. crispiflora* subsp. *crispiflora* was found in the Lesser Antilles and the coastal cordillera of northern Venezuela, while *G. crispiflora* subsp. *discolor* (Rusby) Steyermark was found in the Sierra de Santa Marta of northern Colombia and the Andes of Colombia and Ecuador. Within each of these subspecies, he recognized two allopatric varieties. Steyermark considered the number and degree of development of calyx lobes and the pubescence, particularly its distribution on the leaves, to be taxonomically important in *G. crispiflora*, but noted that number of locules in the ovary and fruits were variable and not particularly informative.

Numerous additional specimens are available today from regions adjacent to Steyermark's study area, and show that Steyermark's broad circumscription of *Guettarda crispiflora* is justified. The collections show also that his classification system is in need of expansion and some realignment, to include the plants of Mesoamerica and those of the Andean Cordillera south to Bolivia. Most of the morphological features that were previously used to

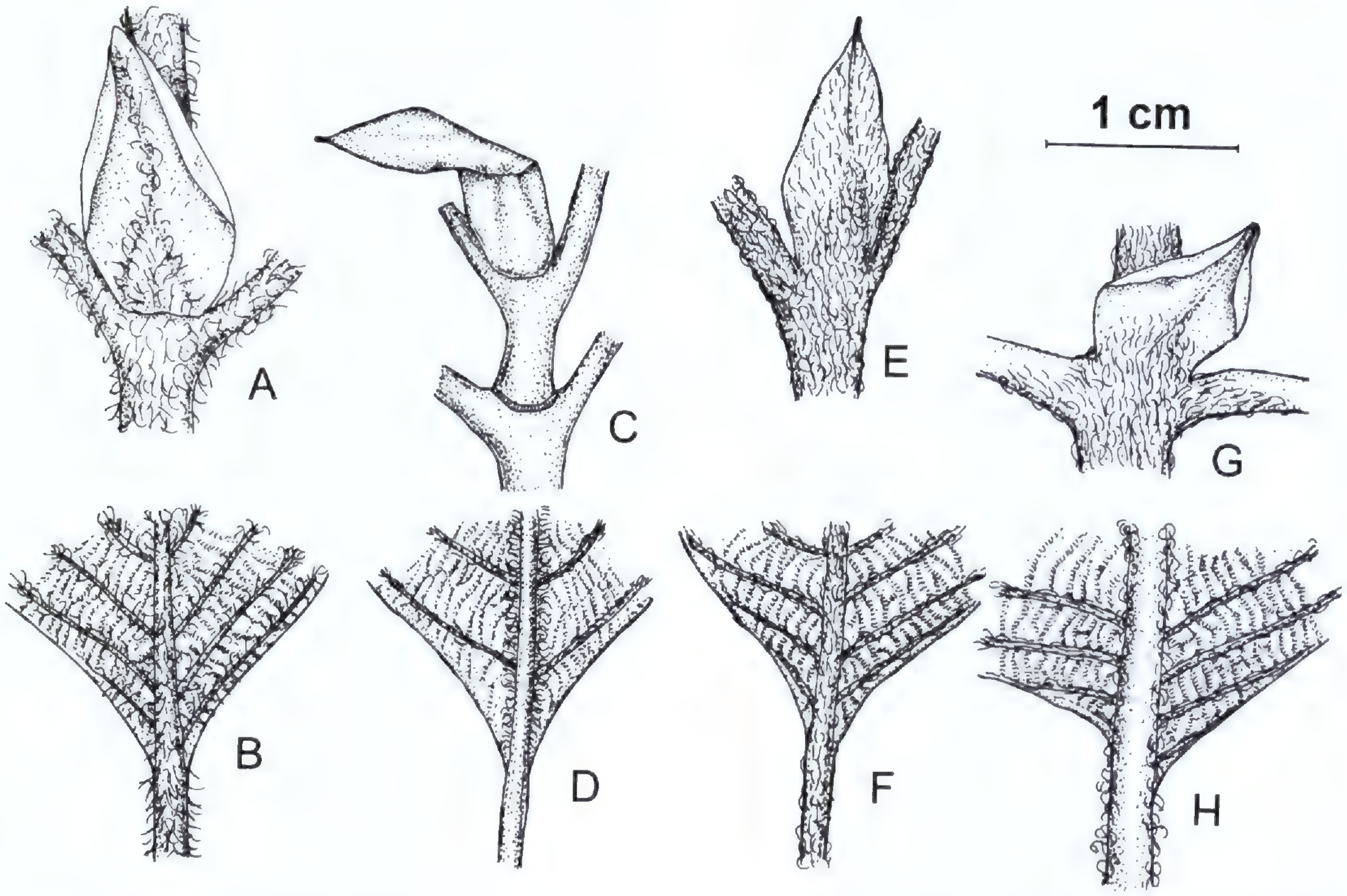


Figure 3. Details of pubescence of four subspecies of *Guettarda crispiflora* Vahl. A, B, *G. crispiflora* subsp. *cobanensis*; based on *Nee 407*.—A. Stipule and stem node. —B. Leaf base and distal portion of petiole. C, D, *G. crispiflora* subsp. *poasana*; based on *Fosberg 47826*.—C. Stem apex showing stipule and two stem nodes. —D. Leaf base and distal portion of petiole. E, F, *G. crispiflora* subsp. *sabiceoides*; based on *Porter 4416*.—E. Stipule and stem node. —F. Leaf base and distal portion of petiole. G, H, *G. crispiflora* subsp. *crispiflora*; based on *Duss 949A*.—G. Stipule and stem node. —H. Leaf base and distal portion of petiole.

separate the species of the "*G. crispiflora* complex" can now be seen to vary continuously throughout this entire area, as discussed below, and no discontinuous variation is observable in any reproductive characters. However, several well-marked entities with clearly demarcated geographic ranges can be distinguished based on vegetative characters.

Although Steyermark relied primarily on calyx lobe length to separate his infraspecific taxa, with more specimens now available this feature does not seem to be informative. Steyermark did not use the total length of the calyx limb, which is 0.8–1.2 mm long in plants from throughout the range of this species, but rather the proportion that is lobed. However, this proportion of lobing is variable and its variation seems to be continuous and uncorrelated with geographic distribution or any other character, so when recent collections are considered his keys no longer work. Here five subspecies are distinguished primarily based on patterns of pubescence type, density, and distribution on the plant; no other characters show clear patterns of variation. These pubescence characters (Fig. 3) are remarkably consistent and closely correlated with geographic distribution; in some cases, details of the leaf shape are also distinctive. The distinctions, characteristics, nomenclature, and geographic ranges of these subspecies are summarized in the key and taxonomic treatment below.

Each of the subspecies of *Guettarda crispiflora* is most similar in general aspect and some morphological features to the geographically adjacent subspecies. The rather close relationships among the subspecies are shown by the subtle nature of their distinctions, the narrow zones of intergradation between some of them, and the sporadic occurrence of plants with characteristics of one subspecies deep within the range of another subspecies. For example, the plants of the Lesser Antilles (subsp. *crispiflora*) are most similar in general aspect to those of northern Central America (subsp. *cobanensis*); the plants of northern Costa Rica (subsp. *poasana*), long treated as a separate species because of their striking, mostly glabrous appearance, overlap or intergrade in a narrow zone in central Costa Rica with the densely pubescent plants found in southern Costa Rica (subsp. *sabiceoides*); and individual

plants that are mostly glabrous, similar to subspecies *poasana*, occur sporadically throughout the range of the species (e.g., Colombia, *Gentry et al. 55267*, MO; Bolivia, *Solomon 13993*, MO).

KEY TO THE SUBSPECIES OF *GUETTARDA CRISPIFLORA*

1. Leaves (at least when young) abaxially densely, closely tomentulose on the areoles, with the blade surface not visible, and sparsely strigillose on the veins including the higher-order venation; northern Venezuela through the Sierra de Santa Marta and the Western Andean Cordillera of Colombia . . . . . c. subsp. *discolor*
1′. Leaves (at least when young) abaxially glabrous on the areoles, with the blade surface visible, and sparsely to densely strigillose to sericeous on the veins including the higher-order venation; Lesser Antilles, Central America, and western Colombia south to Bolivia.
   2. Petioles and stems with the surface not visible, densely strigillose to sericeous or pilosulous to hirsutulous with closely appressed to spreading, densely tangled trichomes; central Costa Rica to Colombia and south through the Andean Cordillera to Bolivia . . . . . e. subsp. *sabiceoides*
   2′. Petioles and stems with the surface visible, glabrous or hirsutulous to pilosulous with spreading tangled trichomes.
      3. Petioles and stems glabrous, or sparsely strigillose when young becoming glabrous with age; northern Costa Rica . . . . . d. subsp. *poasana*
      3′. Petioles and stems hirsutulous to pilosulous with spreading, tangled trichomes; Lesser Antilles and Guatemala to northern Costa Rica.
         4. Leaf bases obtuse to cuneate or acute and often with sides concave; Guatemala to northern Costa Rica. . . . . b. subsp. *cobanensis*
         4′. Leaf bases broadly obtuse to truncate; Lesser Antilles . . . . . a. subsp. *crispiflora*

Guettarda crispiflora Vahl, Eclog. Amer. 36, t. 6. 1796. TYPE: [Lesser Antilles,] Montserrat, *Ryan s.n.* (holotype, C not seen).

a. Guettarda crispiflora subsp. **crispiflora.** Figure 3G, H.

Illustration: Fournet (1978: 1194, fig. 589).

This subspecies is characterized by spreading pubescence and leaves with the bases broadly obtuse to truncate; it is found in the Lesser Antilles [Montserrat, Guadeloupe, Dominica, Martinique, St. Lucia, St. Vincent, and Grenada (Howard, 1989)]. As circumscribed here, this subspecies corresponds to *Guettarda crispiflora* subsp. *crispiflora* var. *crispiflora* of Steyermark (1972: 367–368; Steyermark omitted the typical variety in his nomenclatural citations, but mentioned it in his subsequent discussion). Relatively few specimens of this subspecies have been seen, and it is not clear from these if the Antillean plants are distylous. Loss of distyly has been observed in some species of *Palicourea* in the Antilles (Taylor, 1993) and is presumed to indicate isolation of these plants from conspecific distylous populations on the mainland.

b. Guettarda crispiflora subsp. **cobanensis** (Donnell Smith) C. M. Taylor, comb. et stat. nov. Basionym: *Guettarda cobanensis* Donnell Smith, Bot. Gaz. 47: 255. 1909. TYPE: Guatemala. Alta Verapaz: near Cobán, 1500 m, *von Tuerckheim II.2096* (holotype, US not seen, microfiche). Figure 3A, B.

This species is characterized by spreading pubescence and leaves with the bases obtuse to cuneate or acute; it is found in Guatemala, Nicaragua, and northern Costa Rica.

c. Guettarda crispiflora subsp. **discolor** (Rusby) Steyermark, Acta Bot. Venez. 6: 130. 1971. *Guettarda discolor* Rusby, Descr. N. Sp. S. Amer. Pl. 134. 1920. TYPE: Colombia. Sierra del Libano, region of Santa Marta, 1650 m, 2 Mar. 1898–1899, *H. H. Smith 1809* (holotype, NY not seen, microfiche).

Guettarda steyermarkii Standley, Fieldiana, Bot. 28(3): 576, fig. 125A-B. 1953. Syn. nov. TYPE: Venezuela. Mérida: steep NW- and NE-facing slopes above "La Isla," above Tabay, 2285–2745 m, 18 May 1944, *J. A. Steyermark 56601* (holotype, F).

Guettarda crispiflora subsp. *crispiflora* var. *venezuelensis* Steyermark, Acta Bot. Venez. 6: 129. 1971. TYPE: Venezuela. Aragua: Colombia Tovar, 1900–2000 m, 25 Dec. 1921, *H. Pittier 9967* (holotype, VEN not seen).

Guettarda steyermarkii fo. *pilosior* Steyermark, Acta Bot. Venez. 6: 131. 1971. TYPE: Venezuela. Mérida: 40 km ESE of Tabay, 5 km E of San Juan Bautista, 1000 m, 22 July 1953, *E. L. Little 15372* (holotype, VEN not seen).

Illustration: Steyermark (1974: 802, fig. 128).

This subspecies is characterized by leaves with the pubescence of the abaxial surface of mixed types, closely tomentulose on the areoles and sparsely strigillose on the veins; it is found in the coastal mountain ranges and the Western Cordillera of the Andes in Colombia and Venzuela. Steyermark (1972) distinguished *G. steyermarkii* from *G. crispiflora* by its leaves with "the lower surface . . . densely silvery-gray pubescent" and inflorescences branched twice ("4-branched," i.e., each axis divided and then divided again, vs. once or "2-

branched" in his circumscription of *G. crispiflora*) but noted that that *G. steyermarkii* may not actually be distinct from *G. crispiflora.* Twice-branched inflorescences are found only in a few specimens from Venezuela, and several specimens have both once- and twice-branched inflorescences (e.g., *Liesner 12732,* MO; *Hahn & Grifo 5072,* MO). Plants with twice-branched inflorescences are not distinguished by any other features, and the characteristic pubescence of the abaxial leaf surface noted by Steyermark for this species is the same as the pubescence that characterizes subspecies *discolor.* Therefore, *G. steyermarkii* is not recognized here.

d. Guettarda crispiflora subsp. **poasana** (Standley) C. M. Taylor, comb. et stat. nov. Basionym: *Guettarda poasana* Standley, J. Wash. Acad. Sci. 18: 182. 1928. TYPE: Costa Rica. Alajuela: Viento Fresco, slopes of Volcán Poas, 1800 m, 13 Feb. 1926, *P. C. Standley & Torres 47807* (holotype, US not seen, photo PTBG). Figure 3C, D.

Illustration: Burger and Taylor (1993: 46, fig. 32).

This subspecies is characterized by its glabrous or sparsely strigillose petioles and stems; it is found in northern Costa Rica and intergrades in a narrow strip along the southern edge of its range with subspecies *sabiceoides.* Occasional specimens collected in this contact region show some pubescence features of each subspecies, with the strigillose pubescence characteristic of subspecies *poasana* distributed on the entire stipule and along the abaxial leaf midvein in the pattern characteristic of subspecies *sabiceoides.* These intermediate specimens are considered here to support the inclusion of *G. poasana* within the *G. crispiflora* complex. Because these plants are here considered intermediates between these two subspecies they cannot be keyed to a subspecies in the key above.

e. Guettarda crispiflora subsp. **sabiceoides** (Standley) C. M. Taylor, comb. et stat. nov. Basionym: *Guettarda sabiceoides* Standley, Publ. Field Columbian Mus., Bot. Ser. 4: 291. 1928. *Guettarda crispiflora* subsp. *discolor* var. *sabiceoides* (Standley) Steyermark, Acta Bot. Venez. 6: 130. 1971. TYPE: Colombia. Cauca: forests of the Rio Palacé, highlands of Popayán, 1500–1800 m, *Lehmann B.T. 950* (holotype, K not seen). [Standley cited the type number incorrectly in his original description as "960," but this was later corrected by him (Standley, 1930), and this correction was noted by Steyermark (1971, 1972).] Figure 3E, F.

Guettarda conferta Bentham, Bot. Voy. Sulphur 106. 1845. TYPE: Costa Rica. Cocos Island, *Barclay s.n.* (holotype, BM).

Guettarda ochreata Schlechtendal, Linnaea 28: 496. 1856. TYPE: Peru. San Gavan, Aug. 1854, *Lechler in Hohenacker 2407* (holotype, B not seen, destroyed).

Guettarda pichisensis Standley, Publ. Field Columbian Mus., Bot. Ser. 8: 172. 1930. TYPE: Peru. Junín: Pichis Trail between San Nicolás and Azupuzú, 650–900 m, 6 July 1929, *E. P. Killip & A. C. Smith 26104* (holotype, F).

Guettarda chiriquiensis Standley, Ann. Missouri Bot. Gard. 25: 838. 1938. TYPE: Panama. Chiriquí: valley of upper Rio Chiriquí Viejo, 1300–1900 m, 27 July 1937, *P. White & G. White 22* (holotype, MO; isotypes, A not seen, F).

Guettarda cuatrecasasii Standley ex Steyermark, Acta Biol. Venez. 4: 56, fig. 25–26. 1964. TYPE: Colombia. Caquetá: Cordillera Oriental, vertiente oriental, bosque abierto en Cajón de Pulido, Quebrada del Río Hacha, 1700 m, 26 Mar. 1940, *J. Cuatrecasas 8737* (holotype, F; isotype, US not seen).

Guettarda sordida Standley ex Steyermark, Acta Biol. Venez. 4: 56, fig. 27. 1964. TYPE: Colombia. Caquetá: Cordillera Oriental, vertiente oriental, Quebrada del Río Hacha, abajo de Gabinete, 2100–2250 m, 23 Mar. 1940, *J. Cuatrecasas 8543* (holotype, F; isotype, US not seen).

Illustration: Burger and Taylor (1993: 46, fig. 32).

This subspecies is characterized by pubescence on the vegetative organs that is spreading to appressed and sometimes mixed but not in a consistent or distinctive pattern. It ranges from southern Costa Rica, where it intergrades in a narrow region with subspecies *poasana,* to Bolivia. This subspecies is variable in pubescence pattern generally throughout its range. The plants from the Andes of western Colombia to Bolivia may be better treated in more than one subspecies, but no consistent patterns are evident within this variation at present and these plants are provisionally combined here. For example, the entire range of variation in leaf size and pubescence characters that is found in subspecies *sabiceoides* throughout South America is also found among the plants from the relatively small Bajo Calima region of western coastal Colombia.

Two weakly distinguished patterns of pubescence are evident within Mesoamerican plants of subspecies *sabiceoides.* One of these, the "chiriquiensis" form, is characterized by hirsutulous to pilosulous pubescence throughout the petioles and abaxial leaf surfaces except on the abaxial costa, where the trichomes range from spreading to reflexed; this pubescence pattern is found on the type specimen of *Guettarda chiriquiensis.* Plants with this pubescence pattern are found sporadically in southern Costa Rica, occasionally on Cocos Island, common-

ly in the region of Volcán Chiriquí in western Panama, and infrequently in western Colombia and Ecuador. The other pubescence pattern, the "sabiceoides" form, is characterized by appressed, strigillose to sericeous pubescence, sometimes mixed with a few spreading trichomes, on the petioles and the abaxial leaf surfaces including the abaxial costa, though here the pubescence may become more spreading as the leaf ages; this pubescence pattern is found on the type specimen of *G. sabiceoides*. Plants with this pubescence pattern are found throughout the range of subspecies *sabiceoides*, and this is the most commonly collected pubescence pattern except in the region of the Volcán Chiriquí in Panama.

Guettarda conferta has been separated by previous authors (e.g., Burger & Taylor, 1993) based on its relatively low elevational distribution, 0–300 m, in very wet regions; its relatively numerous secondary leaf veins (12 to 16 pairs), though this condition is also found in occasional plants from higher elevations; and its shorter peduncles (to 1 cm), though this condition is also found in occasional plants from higher elevations. However, with more specimens now available, continuous variation can be found in all the features formerly used to separate this species, and it is not recognized here.

Acknowledgments. We thank the curator of F, Christine Niezgoda, for facilitating access to specimens; R. E. Gereau for preparation of the Latin diagnoses and helpful advice throughout this study; an anonymous reviewer for constructive comments on the manuscript; and Robin Foster, Tyana Wachter, and a grant from the Andrew Mellon Foundation to the Field Museum of Natural History for support for travel to that institution.

Literature Cited

Andersson, L. 1992. A provisional checklist of neotropical Rubiaceae. Scripta Bot. Belg. 1: 1–199.

Burger, W. & C. M. Taylor. 1993. Flora Costaricensis. Family #202, Rubiaceae. Fieldiana, Bot. n.s. 33: 1–333.

Fournet, J. 1978. Flore Illustrée des phanérogames de Guadeloupe et de Martinique. Institut National de la Recherche Agronomique, Paris.

Howard, R. A. 1989. Flora of the Lesser Antilles: Leeward & Windward Islands. Vol. 6: Dicotyledons, Part 3. Arnold Arboretum, Jamaica Plain, Massachusetts.

Standley, P. C. 1930. The Rubiaceae of Colombia. Publ. Field Columbian Mus., Bot. Ser. 7(1): 1–175.

Steyermark, J. A. 1971. Rubiáceas nuevas de Los Andes y Cordillera de la Costa de Venezuela. Acta Bot. Venez. 6: 99–198.

———. 1972. *Guettarda*. *In:* B. M. Maguire & Collaborators, Flora of the Guayana Highlands. Mem. New York Bot. Gard. 23: 357–372.

———. 1974. Rubiaceae. *In:* T. Lasser (editor), Flora de Venezuela 9: 1–2070. Instituto Botánico, Dirección de Recursos Naturales Renovables. Ministerio de Agricultura y Cría, Caracas, Venezuela.

Taylor, C. M. 1993. Revision of *Palicourea* (Rubiaceae: Psychotrieae) in the West Indies. Moscosoa 7: 201–241.

Rubiacearum Americanarum Magna Hama Pars III. Five New Species and a New Subspecies of *Coussarea* (Coussareae) from Central America and Colombia

Charlotte M. Taylor
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.
charlotte.taylor@mobot.org

ABSTRACT. Descriptions and illustrations are presented for the new species *Coussarea antioquiana* from northwestern Colombia, *C. brevipedunculata* from Panama, *C. duplex* from eastern Costa Rica, *C. grandifructa* from southwestern Costa Rica, and *C. izabalensis* from Guatemala, and for the new subspecies *C. loftonii* (Dwyer & M. V. Hayden) Dwyer subsp. *occidentalis* from southern Costa Rica. This third subspecies of *C. loftonii* comprises the westernmost populations of this morphologically variable species.

RESUMEN. Aquí se describen y se ilustran las especies nuevas *Coussarea antioquiana* del noroeste de Colombia, *C. brevipedunculata* de Panamá, *C. duplex* del este de Costa Rica, *C. grandifructa* del sur de Costa Rica y *C. izabalensis* de Guatemala, además la subespecie nueva *C. loftonii* (Dwyer & M. V. Hayden) Dwyer subsp. *occidentalis* del sur de Costa Rica. Esta tercera subespecie de *C. loftonii* incluye las poblaciones más occidentales de esta especie morfologicamente variable.

Key words: Central America, Colombia, *Coussarea*, Coussareae, Mesoamerica, Rubiaceae.

During study of recent collections of *Coussarea* Aublet from Central America and adjacent northwestern Colombia for *Flora Mesoamericana*, the following undescribed taxa were discovered. A summary of the morphology of *Coussarea* has recently been presented (Taylor, 1999). This neotropical genus of about 80 to 95 species is characterized by carnose, indehiscent, spongy, often white fruits with one rather thin-walled seed; the ovaries 1-locular or incompletely 2-locular with one or two basal ovules; flowers that are white, nocturnally fragrant, and usually distylous; salverform corollas with four or occasionally five valvate lobes and stipules that are calyptrate and caducous, or interpetiolar, usually imbricated, caducous to subpersistent, and rounded to acute. The genus comprises species with a notable range of inflorescence arrangements: usually terminal but axillary in some species (e.g., *C. dulcifolia* Neill et al.); bracteate or in some species ebracteate (e.g., *C. amplifolia* C. M. Taylor); and with the flowers usually in multiflowered paniculate arrangements but sometimes in few-flowered cymes (e.g., *C. klugii* Steyermark) or involucrate capitula (e.g., *C. cephaeloides* C. M. Taylor). Some species of *Coussarea* have markedly resinous vegetative buds (e.g., *C. resinosa* C. M. Taylor), and sometimes the inflorescences and flower buds may be coated with resin at least in young stages of development. The shape of the corolla in bud and the shape and size of the axillary vegetative buds are often informative taxonomically. However, the corolla usually elongates markedly just before anthesis, so corolla size measurements based on flower buds are not reliable indicators of the size of the fully developed corolla.

Coussarea antioquiana C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia: municipio de San Luis, Cañón del Río Claro, sector nor-occidental, margen izquierda, 5°53′N, 74°39′W, 330–450 m, 26 Dec. 1983, *A. Cogollo 1136* (holotype, JAUM; isotypes, COL-299949, MO-4289420). Figure 1A, B.

Haec species ad *Coussaream cerroazulensem* Dwyer, *C. cuatrecasasii* Standley ex Steyermark et *C. enneantham* Standley accedens, sed ab eis limbo calicino truncato 5–6 mm tantum longo distinguitur.

Shrubs, treelets, or small trees to 12 m tall; stems puberulent to glabrescent. *Leaves* 9–18 × 4–11 cm, elliptic to broadly elliptic, papyraceous, adaxially glabrous except hirtellous on the costa and secondary veins, abaxially strigillose to hirtellous or pilosulous with pubescence denser on costa and secondary veins, base cuneate to obtuse, apex abruptly acuminate with tip 1–2.5 cm long and frequently falcate; secondary veins 6–8 pairs, looping to interconnect at least in distal part of blade, with small, densely hirtellous domatia in their axils, adaxially all venation plane, abaxially costa prominent and secondary veins and higher-order vena-

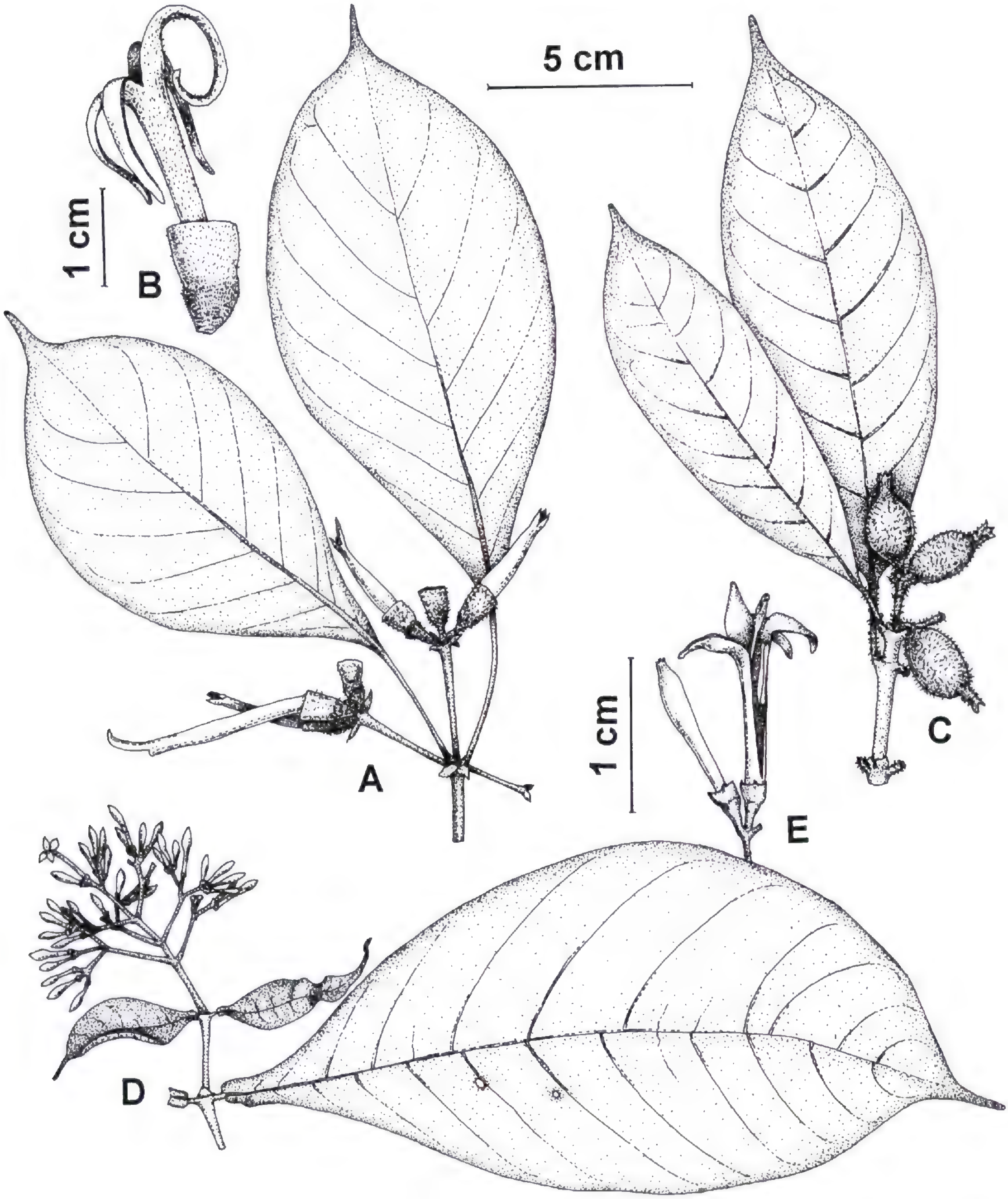


Figure 1. A, B, *Coussarea antioquiana* C. M. Taylor; based on *Cogollo 1136.*—A. Flowering branch. —B. Mature flower. —C. *Coussarea brevipedunculata* C. M. Taylor, flowering branch; based on *McPherson 7876.* D, E, *Coussarea loftonii* (Dwyer & M. V. Hayden) Dwyer subsp. *occidentalis* C. M. Taylor; based on *Induni 255.*—D. Flowering branch. —E. Detail of inflorescence with a flower bud, and a mature flower partially dissected. A, C, D to 5-cm scale.

tion prominulous; *petioles* 2–5 cm long, pilosulous or hirtellous to glabrescent; *stipules* 4–8 mm long, calyptrate, conical to lanceoloid, apically acute, hirtellous or pilosulous to glabrescent, caducous, after falling off leaving visible a persistent fringe of linear colleters 1–3 mm long; axillary buds 2–6 mm long, narrowly lanceoloid, hirtellous or pilosulous. *Inflorescences* terminal, with peduncles 3 or rarely 1, 0.5–1.5 cm long, pilosulous, laterally flattened and usually broadened to apex, each peduncle with 1 to 3 flowers; bracts 2–5 mm long, elliptic to ovate or lanceolate, acute to obtuse, pilosulous. *Flowers* subsessile; hypanthium 3–5 mm long, turbinate, densely pilosulous; *calyx* limb 5–6 mm long, trun-

cate, sparsely to moderately pilosulous; *corolla* in bud cylindrical to fusiform with the lobes unequal in length and shortly separating at their apices (at least on dried specimens), at anthesis salverform, white, externally densely pilosulous to strigillose, tube ca. 20 mm long, ca. 4 mm diam. near middle, lobes 4, ca. 23 mm long, narrowly triangular to narrowly ligulate, acute; mature *anthers* and *stigma* not seen. *Fruits* 20–24 × 15–16 mm, ellipsoid, smooth, yellowish to cream white, sparsely to moderately pilosulous, with truncate calyx limb persistent.

Distribution, habitat, and phenology. In wet forest at 330–935 m in northeastern Antioquia Department, Colombia; collected with flowers in April, May, July, October, and December, with fruits in January, March, June, July, and September through December.

This new species is distinguished by its elliptic to broadly elliptic leaves that are strigillose to hirtellous or pilosulous beneath; its calyptrate, usually pubescent, caducous stipules; its terminal pilosulous inflorescences with one or usually two or three peduncles, each of which produces one to three flowers; its relatively well developed truncate calyx limb; its relatively long, externally densely pubescent corollas; and its relatively large pubescent fruits. *Coussarea antioquiana* has been previously confused with three other species of *Coussarea* that also have pilosulous to hirtellous pubescence, inflorescences of this form, well-developed calyx limbs, and relatively large fruits: *C. cerroazulensis* Dwyer, *C. cuatrecasasii* Standley ex Steyermark, and *C. enneantha* Standley. *Coussarea cerroazulensis* Dwyer of Panama differs in its stipules that are interpetiolar and shortly intrapetiolar, its lobed, usually longer calyx limbs (6–8 mm long), and its shorter corolla lobes (18–20 mm long). *Coussarea cuatrecasasii* of western coastal Colombia differs in its leaves with 9 to 11 pairs of secondary veins, its stipules that are united in an open tube, and its lobed, longer calyx limbs (12–15 mm long). *Coussarea enneantha* from southern Costa Rica to western coastal Colombia differs in its stipules that are interpetiolar and also shortly united intrapetiolarly, its lobed, usually longer calyx limbs (6–13 mm long), its shorter corolla tubes (ca. 15 mm long) and lobes (14–17 mm long), and its usually smaller fruits (14–25 × 9–10 mm). *Coussarea antioquiana* is so far known only from the Río Claro region of Antioquia Department, Colombia, where it is apparently common. The specific epithet refers to its geographic distribution. The region from which this species comes has been studied by Alvaro Cogollo and his collaborators at HUA and JAUM; all of the specimens studied of *C. antioquiana* were collected by this project team.

Paratypes. COLOMBIA. **Antioquia:** municipio de San Luis, corregimiento El Prodigio, vereda Las Confusas, 6°03′N, 74°47′W, *Cárdenas et al. 2551* (JAUM, MO); autopista Medellín–Bogotá, sector Río Samaná-Río Claro, camino hacia la vereda Tulipán, *Cogollo & Estrada 184* (JAUM, MO); cañón del Río Claro, sector nor-occidental, margen izquierda, 5°53′N, 74°39′W, *Cogollo 1139* (COL, JAUM, MO), *1265* (COL, JAUM, MO), *1092* (JAUM, MO); carretera hacia El Prodigio, vereda La Independencia, 6°06′N, 74°48′W, *Cogollo & Cárdenas 3827* (JAUM, MO); carretera de la autopista Medellín–Bogotá hacia el corregimiento El Prodigio, ca. 25 km de la autopista, 6°06′N, 74°48′W, *Cogollo et al. 4561* (JAUM, MO); autopista Medellín–Bogotá, sector Río Samaná-Río Claro, *Hernández & Hoyos 70* (COL, HUA, MO), *Hernández et al. 119* (COL, HUA, MO), *150* (COL, HUA, MO), *206* (COL, HUA), *373* (COL, HUA), *473* (COL, HUA); autopista Medellín–Bogotá, vereda La Josefina, quebrada La Salada, *Hoyos & Hernández 689* (JAUM, MO); quebrada La Cristalina, Sector SE, 6°N, 74°45′W, *Ramírez & Cárdenas 144* (COL, JAUM, MO), *364* (COL, JAUM, MO), *517* (COL, JAUM, MO), *845* (COL, JAUM, MO), *920* (COL, JAUM), *1167* (COL, JAUM, MO), *1305* (COL, JAUM, MO), *1556* (COL, JAUM), *1911* (JAUM, MO); San Luis, *Rentería & Cogollo 2625* (JAUM, MO); Río Claro, carretera al Cairo, margen derecha, *Rentería et al. 2756* (JAUM, MO); corregimiento El Prodigio, vereda Los Medios, cerro la Cuchilla, *Toro 93* (JAUM, MO).

Coussarea brevipedunculata C. M. Taylor, sp. nov. TYPE: Panama. Panamá: near Cerro Jefe, along road towards Alto Pacora, 850 m, 9°15′N, 79°30′W, 27 Dec. 1985, *G. McPherson 7876* (holotype, MO-3618350). Figure 1C.

Haec species *Coussareae enneanthae* Standley similis, sed ab ea infructescentia ex cymula umbelliformi unica pedunculo 1–10 mm longo insidente atque lobulis calycinis in fructu 1–1.5 mm longis distinguitur.

Trees to 8 m tall; stems hirsute with spreading trichomes to 1.5 mm long. *Leaves* 6.5–19 × 2–7 cm, elliptic, chartaceous, adaxially glabrous except hirtellous on costa and secondary veins, abaxially hirsute with the pubescence denser on costa and secondary veins, base cuneate to acute, apex acute to usually acuminate with tip 0.5–1.5 cm long; secondary veins 5 to 10 pairs, looping to interconnect, without domatia, adaxially costa and secondary veins sulcate and higher-order venation plane to prominulous, abaxially costa prominent and secondary veins and higher-order venation prominulous; *petioles* 8–25 mm long, densely hirtellous to hirsute; *stipules* 3–4 mm long, interpetiolar and shortly united intrapetiolarly as well, hirtellous to glabrous, deciduous before leaves, interpetiolar portion deltoid to broadly triangular, obtuse to rounded, resinous; axillary buds 2–3 mm long, ovoid. *Inflorescences* not seen. *Infructescences* with

peduncle 1, 1–10 mm long, hirtellous to hirsute, producing 1 or 3 umbelliform cymules; bracts to 2 mm long, narrowly triangular; pedicels to 2 mm long. *Fruits* 1–3 per peduncle, ca. 17 × 11 mm, ellipsoid, yellow, smooth, densely hirtellous to hirsute, with persistent calyx limb 5–9 mm long, shortly lobed, the lobes 4, 1–1.5 mm long, ligulate, rounded to obtuse.

Habitat, distribution, and phenology. Wet forest at 800–900 m in central Panama; collected in fruit October through January.

This new species has been confused previously (e.g., Dwyer, 1980) with *Coussarea enneantha* of Panama and northwestern South America, which is generally similar in overall aspect and pubescence. However, *C. enneantha* differs in its 1 to 3 longer peduncles (20–50 mm long), its flowers borne singly or in small glomerules in dichasial cymules, and its longer calyx lobes (2–6 mm long). The specific epithet of this new species refers to its distinctive relatively short peduncles.

Paratypes. PANAMA. **Panamá:** Cerro Jefe along main road before turnoff to summit, *Croat 13052* (MO, SCZ); Cerro Brewster, on San Blas border, 9°20′N, 79°15′W, *McPherson 7546* (MO), *7549* (MO); Cerro Jefe, 1.5 km before weather station, *Sytsma 1516* (MO).

Coussarea duplex C. M. Taylor, sp. nov. TYPE: Costa Rica. Limón: Cantón de Limón, El Progreso, entre Cerro Muchilla y Cerro Avioneta, cabeceras del Río Suruy, Fila Matama, Valle de la Estrella, 9°47′25″N, 83°06′30″W, 550 m, 17 Apr. 1989, *G. Herrera & A. Chacón 2646* (holotype, MO-3844770). Figure 2C.

Haec species *Coussareae talamancanae* Standley similis, sed ab ea stipulis alabastris axillaribus petiolo limbo calycino fructuque omnibus ca. duplo majoribus quam hujus distinguitur.

Small trees to 8 m tall, glabrous. *Leaves* 13.5–31 × 7–22 cm, broadly elliptic to obovate, chartaceous, base obtuse to rounded, apex shortly acute to acuminate; secondary veins 8 to 10 pairs, occasionally looping to interconnect, without domatia, adaxially costa and secondary veins prominulous and higher-order venation plane, abaxially costa prominent, secondary veins prominulous, and higher-order venation plane to prominulous; *petioles* 25–50 mm long; *stipules* 18–20 mm long, calyptrate, narrowly pyramidal, at apex acute to apiculate, caducous; axillary buds ca. 20 mm long, narrowly conical. *Inflorescences* 8–15 × 3–4 cm, racemiform, glabrous, ebracteate, unbranched; peduncle 1; pedicels 1.5–2 mm long, borne directly from primary axis, singly or in umbelliform clusters of 2 to 4. *Flowers* with hypanthium ca. 2 mm long, cylindrical, puberulous; *calyx* limb ca. 3 mm long, infundibuliform, truncate, glabrous, white; *corolla* in bud cylindrical to fusiform, obtuse, externally glabrous, lobes 4, at anthesis not seen; *anthers* and *stigmas* not seen. *Fruits* 25–30 × 10–12 mm, ellipsoid, laterally somewhat flattened, white, smooth.

Distribution, habitat, and phenology. Wet forests at 200–850 m on the Caribbean slopes of central Costa Rica; collected in flower bud in April and September, in fruit in September.

This new species is distinguished by its relatively large, broadly elliptic to obovate leaves, calyptrate stipules, spiciform inflorescences with the flowers borne directly from the primary axis, well-developed truncate calyx limbs, and laterally somewhat flattened fruits. It is similar to *Coussarea talamancana* Standley; *C. duplex* differs principally in its stipules, axillary buds, petioles, calyx limbs, and fruits all about twice as long as those of *C. talamancana*, and the specific epithet refers to this contrast.

Paratypes. COSTA RICA. **Limón:** Cordillera de Talamanca, ridge separating Quebrada Cañabral from Río Barbilla, and slope leading down to the latter, 10°02′N, 83°26′W, *Grayum et al. 8754* (MO); Cantón de Limón, Cordillera de Talamanca, Cerro Muchilla, Fila Matama, entrando por el pueblo El Progreso, 9°47′40″N, 83°06′30″W, *Robles & Chacón 2748* (MO).

Coussarea grandifructa C. M. Taylor, sp. nov. TYPE: Costa Rica. Puntarenas: Reserva Forestal Golfo Dulce, Osa Peninsula, Rancho Quemado, ca. 15 km W of Rincón, in bottom of valley along Río Riyito near bridge and in forest along road on ridge above valley, 8°42′N, 83°33′W, 250 m, 31 May 1988, *B. Hammel, G. Herrera, M. M. Chavarría & A. Solís 16950* (holotype, MO-3846254). Figure 2A, B.

Haec species *Coussareae psychotrioidi* C. M. Taylor & Hammel similis, sed ab ea limbo calycino longiore distinguitur.

Shrubs, treelets, or trees to 6 m tall, glabrous. *Leaves* 8.5–27 × 2.6–6 cm, elliptic, papyraceous, base acute to cuneate, apex acute to acuminate; secondary veins 7 to 10 pairs, looping to interconnect, without domatia, on both surfaces costa, secondary veins, and higher-order venation plane to prominulous; *petioles* 5–18 mm long; *stipules* 0.8–1 mm long, united into a tube, truncate, persistent; axillary buds inconspicuous. *Inflorescences* 4–7 × 2–8 cm, paniculate, in outline rounded-corymbiform to broadly pyramidal, glabrous, with flowers

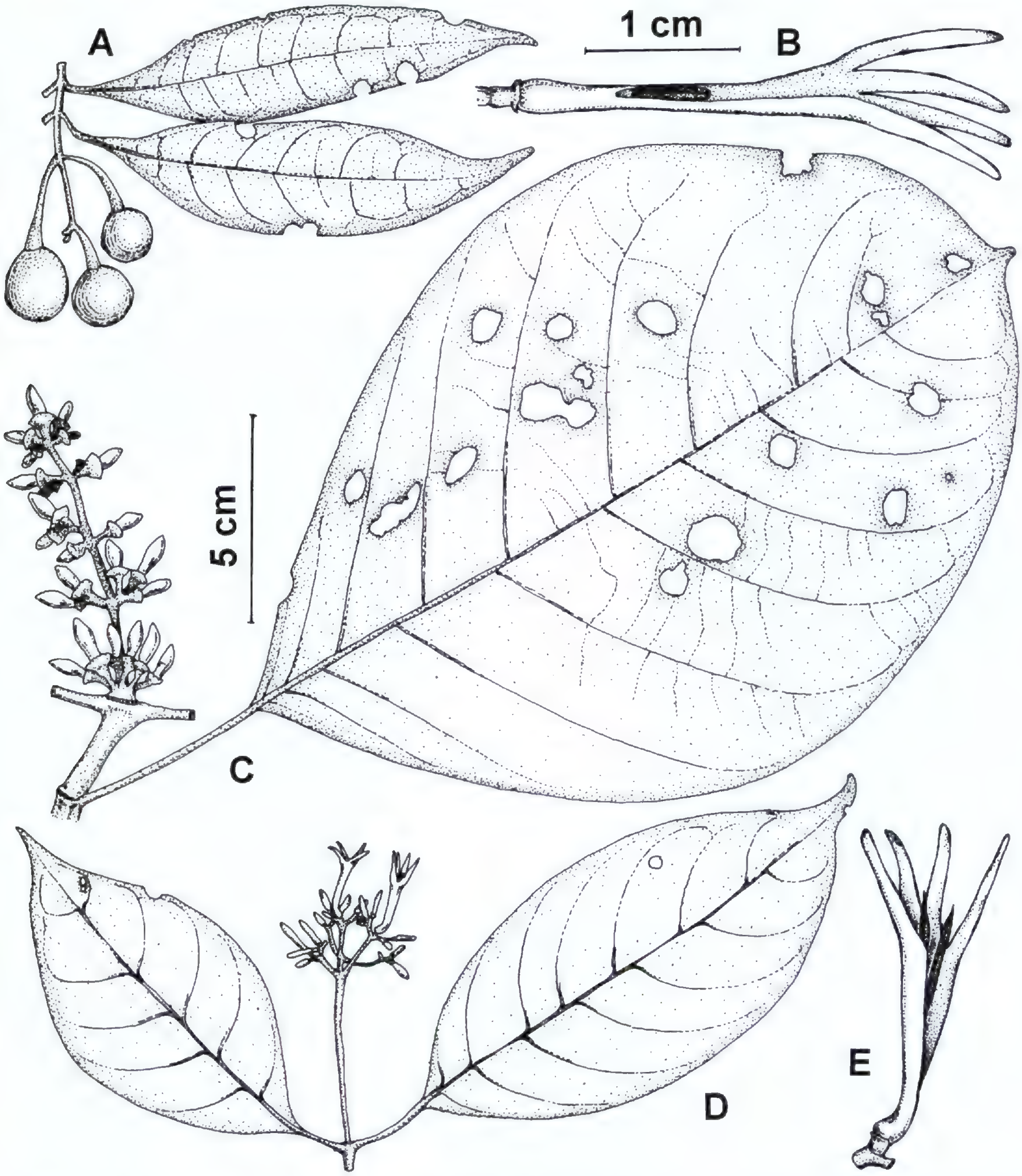


Figure 2. A, B, *Coussarea grandifructa* C. M. Taylor; based on *Liesner 1893*.—A. Fruiting branch. —B. Mature flower, partially dissected. —C. *Coussarea duplex* C. M. Taylor, flowering branch; based on *Herrera 2646*. D, E, *Coussarea izabalensis* C. M. Taylor, based on *Contreras 11354*.—D. Flowering branch. —E. Mature flower, partially dissected.

sessile in dichasial cymules of 3 to 5; peduncle 1; bracts to 3 mm long, linear. *Flowers* with hypanthium 1–1.5 mm long, cylindrical, glabrous; *calyx* limb 0.8–1 mm long, glabrous, truncate except minutely 5-denticulate with teeth widely separated; *corolla* in bud narrowly cylindrical to fusiform, acute to obtuse, at anthesis salverform, white, glabrous externally, tube 13–17 mm long, ca. 1.5 mm diam. near top of tube, lobes 5, 12–16 mm long, linear to narrowly ligulate, obtuse; *anthers* 4.5–5 mm long, included or partially exserted, apically with a short acute appendage; *stigmas* 2–4 mm long, exserted. *Fruits* ca. 15 mm diam., ellipsoid, blue-black or purple-black, smooth, sometimes shortly stipitate, with infructescence axes usually markedly thickened in their most distal portions.

Distribution, habitat, and phenology. Wet forest

at 20–400 m in the Osa Peninsula of southern Costa Rica; collected in flower April through June, in fruit in January, February, and August.

This new species is distinguished by its persistent stipules united into a short tube, corymbiform-rounded inflorescence, and relatively large fruits borne on infructescence axes that usually become markedly thickened. It is similar to *Coussarea psychotrioides* C. M. Taylor & Hammel of northeastern Costa Rica; however, *C. psychotrioides* differs in its shorter calyx limb (ca. 0.3 mm long) and its ligulate, usually shorter corolla lobes (10–12 mm long). Both of these species have fruits that are relatively large for *Coussarea*; the specific epithet of this new species refers to this feature. With the material available it is not possible to determine if the flowers of this species are distylous or not.

Paratypes. COSTA RICA. **Puntarenas:** Fila before Rancho Quemado, near Rincón, Osa Peninsula, 8°42′N, 83°33′W, *Gentry et al. 78663* (MO sterile), *78701* (MO); Reserva Forestal Golfo Dulce, Osa Peninsula, Rancho Quemado, ca. 15 km W of Rincón, along road to Drake at N end of valley, 8°44′N, 83°45′W, *Hammel et al. 17031* (MO); slopes adjacent to airport, Rincón de Osa, *Liesner 1893* (MO); Golfito, Refugio de Vida Silvestre, valle de Coto Colorado, Fila Gambas, 8°40′10″N, 83°11′50″W, *Martén & Céspedes 803* (MO), 8°41′N, 83°12′W, *Segura et al. 82* (CR, MO); Parque Nacional Corcovado, cima de Cerro Rincón, 8°32′N, 83°28′W, *Morales et al. 19* (INB, MO); Aguabuena, 3 km W of Rincón, 800 m N of the house of Henry Monge, 8°42′N, 83°30′W, *Thomsen 345* (MO).

Coussarea izabalensis C. M. Taylor, sp. nov. TYPE: Guatemala. Izabal: El Estor, 17 Mar. 1972, *E. Contreras 11354* (holotype, MO-4332300). Figure 2D, E.

Haec species *Coussareae psychotrioidi* C. M. Taylor & Hammel similis, sed ab ea stipulis longioribus, lobulis corollinis brevioribus atque fructu minore distinguitur.

Shrubs or small trees to 10 m tall, glabrous. *Leaves* 9–15 × 3.5–6.5 cm, elliptic, papyraceous to chartaceous, base cuneate, apex acuminate with tip 1–2 cm long and often falcate; secondary veins 5 to 7 pairs, sometimes looping to interconnect, without domatia, on both surfaces costa and secondary veins prominulous and higher-order venation plane to prominulous; *petioles* 8–20 mm long; *stipules* 1–3 mm long, united into a tube, truncate to rounded, persistent; axillary buds inconspicuous. *Inflorescences* 3–8 × 3.5–6 cm, paniculate, in outline broadly pyramidal to corymbiform, ebracteate, glabrous, with flowers sessile or subsessile in cymules of 3 to 7; peduncle 1. *Flowers* apparently distylous; hypanthium 0.8–1 mm long, cylindrical, glabrous; *calyx* limb 0.1–0.2 mm long, truncate; *corolla* in bud fusiform, somewhat curved, obtuse, at anthesis salverform, white, externally glabrous, tube ca. 13 mm long, lobes 4 or 5, 8–9 mm long, narrowly triangular, rounded; *anthers* ca. 5.5 mm long and partially exserted, apically with a short acute appendage; *stigmas* ca. 5 mm long with style ca. 7 mm long. *Fruits* ca. 10 mm diam., oblate to subglobose, smooth, mature color unknown; seeds 2.

Distibution, habitat, and phenology. Wet forests of lowland northeastern Guatemala; collected in flower in March, in fruit in July and September.

This new species is distinguished by its persistent stipules united around the stem into a short sheath, broadly pyramidal to corymbiform, ebracteate inflorescences, relatively reduced calyx limbs, slender, white, and often curved corollas. It is similar to *Coussarea psychotrioides* of northeastern Costa Rica and *C. mediocris* Standley & Steyermark of Guatemala. However, *C. psychotrioides* differs in its usually shorter stipules (0.5–1 mm long), its longer corolla lobes (10–12 mm long), and its larger fruits (15–20 × 12–16 mm); while *C. mediocris* differs in its longer hypanthium (ca. 1.5 mm long), longer calyx limb (ca. 0.5 mm long), and shorter corolla tubes (ca. 2.5 mm long). The specific epithet refers to the region in Guatemala where this new species has been collected. Only one floral form has been seen, but the relative positions of the anthers and stigmas are similar to those of short-styled flowers of distylous species of *Coussarea*, so this species may also be distylous.

Paratypes. GUATEMALA. **Izabal:** between Seja and Cienaga, 5 km from Seja, 200 m E of the road, *Contreras 10198* (MO); Puerto Méndez, on Río Dulce Road, 26 km, *Contreras 10311* (MO); El Estor, *Contreras 11399* (MO).

Coussarea loftonii (Dwyer & M. V. Hayden) Dwyer subsp. **occidentalis** C. M. Taylor, subsp. nov. TYPE: Costa Rica. Puntarenas: Parque Nacional Corcovado, Los Planes, La Gloria, 8°37′30″N, 83°40′50″W, 170 m, 17 Feb. 1991, *G. Induni 255* (holotype, INB; isotype, MO-4602197). Figure 1D, E.

Haec subspecies a subspecie typica foliis obovatis majoribus basi truncatis vel cordulatis, limbo calycino plerumque brevior atque corollae tubo lobulisque brevioribus distinguitur, habitat in regionibus occidentalibus meridionalibusque.

Shrubs or small trees to 7 m tall, glabrous. *Leaves* 14.5–25 × 5–13 cm, obovate to oblanceolate, papyraceous, base truncate to shortly cordate, apex acuminate with tip 1–3 cm long and usually falcate; secondary veins 7 to 11 pairs, weakly looping to interconnect, with pilosulous domatia in axils, on

both surfaces costa and secondary veins prominulous and higher-order venation plane to prominulous; *petioles* 3–5 mm long; *stipules* 2–3 mm long, interpetiolar and also shortly united intrapetiolarly, deciduous before leaves, interpetiolar portion deltoid; axillary buds inconspicuous. *Inflorescences* 4–7 × 4–7 cm, paniculate, in outline pyramidal, glabrous to puberulous, ebracteate, with the flowers in umbelliform cymules of 2–8; peduncle 1; pedicels 1–1.5 mm long. *Flowers* apparently distylous; hypanthium ca. 1 mm long, ellipsoid to cylindrical, puberulous to glabrous; *calyx* limb 1–2 mm long, glabrous, truncate except shortly 4-denticulate with teeth widely separated; *corolla* in bud fusiform, acute, at anthesis salverform, white, externally glabrous, tube 9.5–10 mm long, ca. 1 mm diam. near middle, lobes 4, 4–5 mm long, narrowly triangular, acute; *anthers* ca. 4.5 mm long, included to partially exserted; *stigmas* ca. 2 mm long, exserted. *Fruits* ca. 12 × 7 mm, ellipsoid, smooth, laterally somewhat flattened, mature color unknown (white in other subspecies).

Distribution, habitat, and phenology. Wet forest at 0–850 m in the Osa Peninsula of southern Costa Rica, also Caribbean slopes from central Costa Rica to western Panama; collected in flower January through March and in May, in fruit in September.

As it is circumscribed here, *Coussarea loftonii* (Dwyer & M. V. Hayden) Dwyer is found from central and southern Costa Rica eastward through Panama, and then south along the Pacific coast of Colombia. Across its range it shows marked morphological variation that seems to be clinal. This species is here considered to comprise three subspecies: subsp. *loftonii,* found in central and eastern Panama; subsp. *calimana* C. M. Taylor, found in the Pacific coastal plain of Colombia (Taylor et al., 1999); and this new subspecies, found from southern and central Costa Rica to western Panama. These three taxa appear at present to be allopatric, and are separated as outlined in the key below.

Morphological variation within *Coussarea loftonii* is particularly marked in the length of the calyx limb, which is longest in Colombian plants and shortest in the Costa Rican plants; in the length of both the corolla tube and the corolla lobes, which are longer in plants of central and eastern Panama than in those of Costa Rica (mature corollas from the Colombian plants have not yet been seen); and in the form of domatia in the vein axils on the leaf undersides. These domatia are glabrous and foveolate (i.e., crypt-type) in Colombian plants; pilosulous and open, with only a low ring of raised peripheral tissue, in plants from central Panama; and pilosulous and completely smooth or with only a very reduced ring of peripheral tissue in Costa Rican plants.

This new subspecies occupies the western part of the range of *Coussarea loftonii,* and its epithet refers to this distribution. *Coussarea loftonii* subsp. *occidentalis* was included by Burger and Taylor (1993) in *C. curvigemmia* Dwyer, and has also been confused with *C. impetiolaris* Donnell Smith. However, *C. curvigemmia* as circumscribed here is restricted to central Panama and differs from *C. loftonii* in its leaves that are rounded to occasionally truncate at the base, its foveolate domatia that are glabrous to only sparsely pilosulous, its ovoid longer axillary buds (1–3 mm long), and its corollas that are linear to clavate with the apex obtuse in bud, and at anthesis have longer tubes (14–18 mm long) and lobes (7–10 mm long). As circumscribed here *C. impetiolaris* is found on the Caribbean slopes of Nicaragua, Costa Rica, and western Panama, and differs from *C. loftonii* in its quickly caducous stipules, its inflorescences that are cylindrical to rounded in outline, its longer inflorescence bracts (to 1.5 mm long), its inflorescence axes that are pilosulous in lines at the nodes, its corollas that are cylindrical to clavate with the apex obtuse in bud and at anthesis are densely tomentellous to velutinous externally, its longer corolla lobes (6–10 mm long), and its larger fruits (15–20 × 14–15 mm). Only one floral form has been seen, but the relative positions of the anthers and stigmas are similar to those of long-styled flowers of other species of *Coussarea.*

KEY TO THE SUBSPECIES OF *COUSSAREA LOFTONII*

1. Calyx limb 4–5 mm long; fruits ca. 20 × 25 mm; western Colombia . . . . . subsp. *calimana*
1′. Calyx limb 1–3 mm long; fruits 12–15 × 7–10 mm; Costa Rica and Panama.
   2. Leaves 7–15 × 1.7–7 cm, at base narrowly rounded to truncate; petioles 5–30 cm long; calyx limb 2–3 mm long; corollas with tubes 10.5–12 mm long and lobes 6–9 mm long; central and eastern Panama . . . . subsp. *loftonii*
2′. Leaves 14.5–25 × 5–13 cm, at base truncate to shortly cordate; petioles 3–5 mm long; calyx limb 1–2 mm long; corollas with tubes 9.5–10 mm long and lobes 4–5 mm long; Costa Rica and western Panama . . . . . subsp. *occidentalis*

Paratypes. COSTA RICA. **Limón:** 7 km SW of Bribri, *L. D. Gómez et al. 20388* (CR, MO). **Puntarenas:** Reserva Forestal Golfo Dulce a 10 km de Chacartia, 8°45′N, 83°18′W, *Aguilar 894* (CR, MO); Parque Nacional Cor-

covado, Los Planes (La Gloria), 8°37′N, 83°40′50″W, *Castro 298* (CR, MO); Reserva Indígena Cuaymí, Alto Laguna, Osa, 8°36′40″N, 83°31′20″W, *Cordero 20* (CR, MO), *21* (CR, MO); Reserva Forestal Golfo Dulce, Osa Península, Rancho Quemado, on trail to Drake on ridge at N end of valley, on slope leading down to Guerra, 8°44′N, 83°36′W, *Hammel et al. 16804* (CR, MO); Parque Nacional Corcovado, Llorona, Llorona Trail, *Kernan et al. 970* (CR, MO); Reserva Forestal, Golfo Dulce, Cantón de Osa, Rancho Quemado, ca. 15 km W of Rincón de Osa, along Río Riyito, *Solomon 19297* (CR, MO). PANAMA. **Bocas del Toro:** camino a Quebrada Bonyic, antes de llegar a Quebrada Carbón, *Santamaría & Lara 1042* (MO, PMA).

Acknowledgments. I thank R. E. Gereau for preparation of the Latin diagnoses; the curators of COL, F, HUA, and JAUM for access to specimens; two anonymous reviewers for constructive comments on this manuscript; Robin Foster, Tyana Wachter, and the Andrew Mellon Foundation through a grant to the Field Museum of Natural History for support for travel to that institution; and Quírico Jiménez and Mireya Correa for providing information about specimens in some Central American herbaria.

Literature Cited

Burger, W. C. & C. M. Taylor. 1993. Flora Costaricensis: Family #202. Rubiaceae. Fieldiana, Bot. n.s. 33: 1–333.

Dwyer, J. D. 1980. Flora of Panama Part IX. Family 179. Rubiaceae. Ann. Missouri Bot. Gard. 67: 1–522.

Standley, P. C. & L. O. Williams. 1975. Flora of Guatemala—Part IX (Rubiaceae). Fieldiana, Bot. 24: 1–274.

Taylor, C. M. 1999. Rubiaceae–Coussareae. *In:* G. Harling & L. Andersson (editors), Fl. Ecuador 62: 238–307.

———, W. Devia, A. Cogollo & C. Persson. 1999. Nuevos taxones de Rubiaceae de la Costa Pacífica de Colombia y Ecuador. Novon 9: 431–440.

Una Especie Nueva de *Bauhinia* (Fabaceae: Caesalpinioideae: Cercideae) de Panamá

Rafael Torres Colín

Departamento de Botánica, Instituto de Biología, Universidad Nacional Autónoma de México, Apartado Postal 70-367, Del. Coyoacán, 04510, México, D.F., México.
colin@mail.ibiologia.unam.mx

RESUMEN. Se describe e ilustra a *Bauhinia coclensis*, especie nueva de Fabaceae endémica de Panamá, esta relacionada con *B. cookii* Rose y *B. seleriana* Harms de la sección *Amaria* por su hábito arborescente o arbustivo, estípulas triangulares, cáliz de 1–2 cm de largo, pétalos ovado-elípticos y androceo de 10 estambres connatos en la base; se diferencia de ellas por tener el tubo calicinal 5-alado.

ABSTRACT. *Bauhinia coclensis*, a new species of Fabaceae endemic to Panama, is described and illustrated. It resembles *B. cookii* Rose and *B. seleriana* Harms, both in section *Amaria* and characterized by an arborescent or shrubby habit, ovate, lanceolate, or triangular stipules, calyx 1–2 cm long, elliptic or lanceolate petals, and androecium of 10 connate stamens, but differs from them in its 5-winged calyx tube.

Key words: *Bauhinia*, Caesalpinioideae, Cercideae, Fabaceae, Panama.

En la región del sureste de México y Centroamérica existen 32 especies de árboles, arbustos y bejucos del género *Bauhinia* (Torres, 1999). Durante la preparación del tratamiento de este género para Mesoamérica fue descubierta la siguiente especie nueva.

Bauhinia coclensis R. Torres, sp. nov. TIPO: Panamá. Coclé: area surrounding Rivera Sawmill, 7 km N of El Cope, continental divide, 750–850 m, 24 Nov. 1977, *J. P. Folsom & Leo Collins 6434* (holótipo, MEXU; isótipos, MEXU, MO). Figura 1.

Arbor 6 m alta. Folia bilobata, fissa per 1/8 longitudinis eorum, subcoriacea, 5-nervia, glabra; stipulis triangularibus 1.3–2.7 × 0.5–0.7 mm, vix strigosis vel glabris. Inflorescentiae racemosae. Flos calyce ca. 1.5 × 1 cm, 5-alato; petalis lanceolatis, imbricatis, sessilibus; staminibus 10, ad basem connata.

Arboles c. 6 m, inermes. Hojas (3.6–)5–10 (–11.4) × (1.7–)2–4.5 cm, 2-lobadas, partidas 1/8 de su longitud, lóbulos divaricados, la lámina estrechamente elíptica, subcoriácea, 5-nervada, haz y envés glabros, la base obtusa, el ápice de los lóbulos agudo; estípulas 1.3–2.7 × 0.5–0.7 mm, triangulares, escasamente estrigulosas a glabras; pecíolo 0.8–1.2 cm, canaliculado, glabro. Inflorescencias con 3 a 6 flores, racemosas, axilares; raquis escasamente estriguloso-ferrugíneo; botones c. 1 × 0.5 cm, amarillentos, escasamente estrigulosos; bráctea 0.5–0.9 × 0.2–0.4 mm, triangular, escariosa; bractéolas 0.6–0.8 × 0.2–0.5 mm, lanceoladas a triangulares, escariosas; pedicelos 0.2–0.4 cm, escasamente estrigulosos, ferrugíneos. Flores hermafroditas; hipantio c. 4 × c. 2.5 mm, 5-alado; cáliz (en botón) c. 1.5 × c. 1 cm, 5-alado, escasamente estrigoso; corola (en botón) con 5 pétalos, c. 0.8 × c. 0.3 cm, imbricados, sésiles, la lámina elíptica a lanceolada, glabra; estambres (en botón) 10; con 5 c. 0.3 cm y 5 c. 0.6 cm, connatos en la base; anteras 2.3–4 × c. 1 mm, lanceoladas, glabras; gineceo c. 0.3 cm (inmaturo), oblongo, estriguloso, ferrugíneo. Legumbre y semillas no vistas.

Distribución y hábitat. Es una especie endémica de Panamá y habita en selvas tropicales.

Por su hábito arborescente, estípulas triangulares, cáliz 1–2 cm de largo, pétalos elípticos a lanceolados y androceo de 10 estambres connatos en la base, *Bauhinia coclensis* se asemeja a *Bauhinia cookii* y *B. seleriana* del subgénero *Bauhinia*, especies centroamericanas (no presentes en Panamá) de la sección *Amaria*, pero difiere de ellas y del resto de especies centroamericanas de *Bauhinia* en que tiene el tubo calicino 5-alado. Las similitudes no necesariamente reflejan un parentesco con las especies mencionadas ya que el material de estudio aún resulta escaso e incompleto para establecer vínculos de parentesco.

De acuerdo con Wunderlin et al. (1987), la sección *Amaria* contiene aproximadamente 15 especies distribuidas del norte de Sudamérica a México, en Panamá ocurren *Bauhinia beguinotii* Cufodontis y *B. petiolata* (Mutis ex DC.) Triana ex Hooker, las

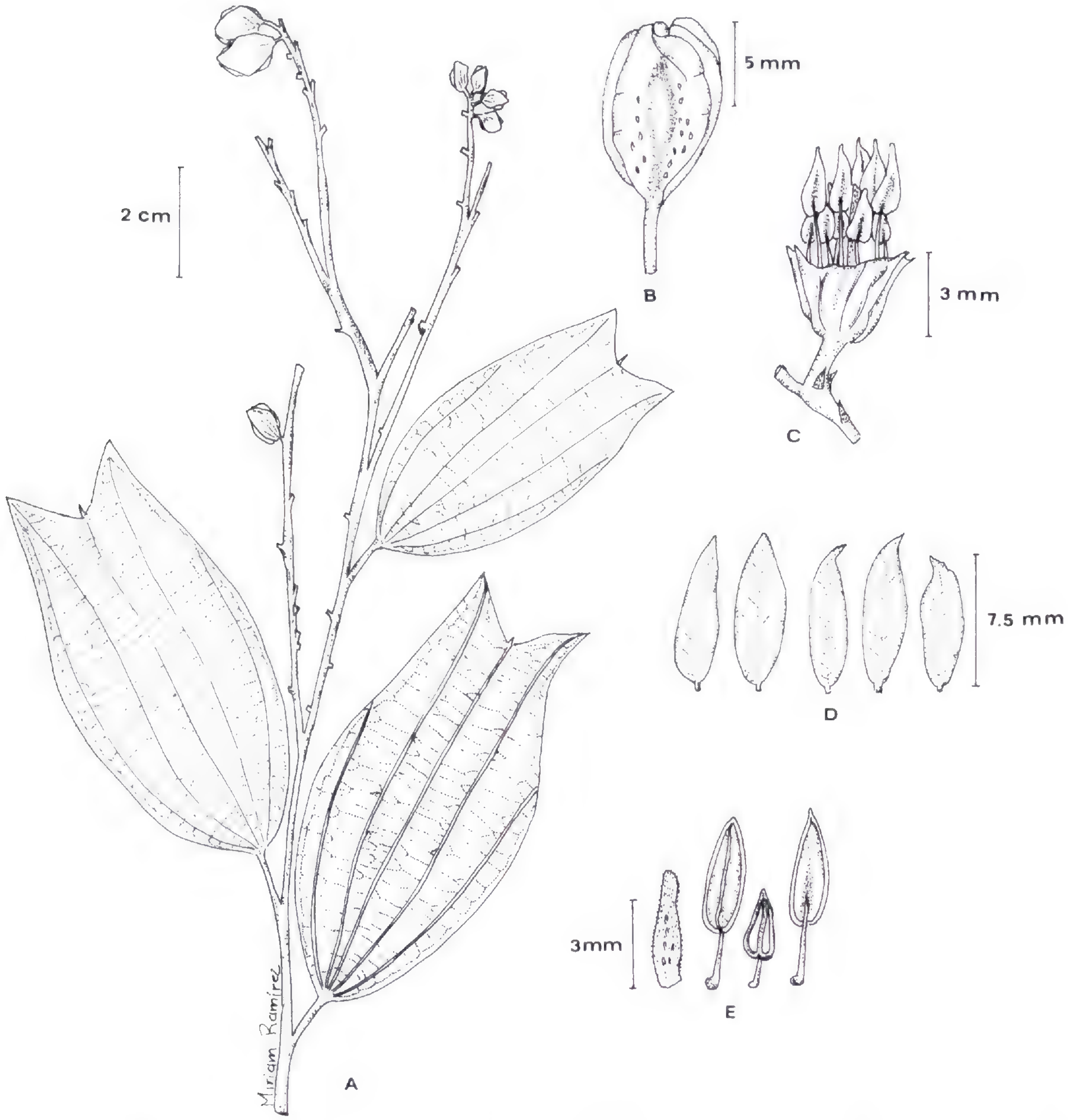


Figura 1. *Bauhinia coclensis* R. Torres. —A. Rama con inflorescencia en botón. —B. Botón 5-alado. —C. Flor hermafrodita en botón con el cáliz y pétalos removidos. —D. Pétalos. —E. gineceo inmaturo y estambres (basado en holótipo, *Folsom & Collins 6434*, MEXU).

cuales en estado estéril se pueden diferenciar de *Bauhinia coclensis* por tener hojas enteras, así como *B. picta* (Kunth) DC. cuyas hojas son bilobadas pero se diferencian de *B. coclensis* por tener la lámina de las hojas anchamente ovada y 9 a 13 nervada (Torres, 1999). Otras especies como *Bauhinia alata* y *B. pterocalyx* tienen caliz alado y androceo de 10 estambres (Vaz, 1979), sin embargo pertenecen a la sección *Caulotretus* del subgénero *Phanera* (Wunderlin et al., 1987) y difieren de la sección *Amaria* en que son bejucos con estípulas falcadas cuando presentes, los pétalos oblongos a obovados y tienen los estambres libres, desiguales.

El nombre de esta especie se refiere a la localidad de Coclé en Panamá, de donde sólo es conocida por las colecciones tipo y se desconoce que tan rara es la planta y cual es el estado actual del hábitat en cuanto a destrucción.

Agradecimientos. El autor agradece a Mario Sousa Sánchez la asesoría que me brindó y por la revisión de este trabajo. A Fernando Chiang Cabrera por la revisión del manuscrito y por haber latinizado la descripción original. A Miriam Ramírez de Anda por la realización de la ilustración. Un reconocimiento al herbario del Missouri Botanical Garden, por el obsequio para determinación del ejemplar examinado.

Literatura Citada

Torres, C. R. 1999. El género *Bauhinia* (Leguminosae: Caesalpinioideae: Cercideae) en Mesoamérica. Tesis de Maestria, Facultad de Ciencias, Universidad Nacional Autónoma de México, México D.F.

Vaz, A. M. S. Da F. 1979. Considerações sobre a taxonomia, do gênero *Bauhinia* L. sect. *Tylotaea* Vogel (Leguminosae–Caesalpinioideae) do Brasil. Rodriguésia 31(51): 127–234.

Wunderlin, R. P., K. Larsen y S. S. Larsen. 1987. Reorganization of the Cercideae (Fabaceae: Caesalpinioideae). Biol. Skr. 28: 1–40.

A New Species of *Cyrtandra* (Gesneriaceae) from Kaua'i, Hawaiian Islands

Warren L. Wagner

Department of Botany, MRC-166, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560, U.S.A. wagner.warren@nmnh.si.edu

Kenneth R. Wood and David H. Lorence

National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Hawaii 96741-9599, U.S.A.

ABSTRACT. A rare new species of the Pacific genus *Cyrtandra, C. paliku,* is described from the Hawaiian Islands. It is unique in its combination of thick stems with shaggy, reddish brown villous pubescence, leaves strongly inequilateral, petioles shaggy villous, and calyx weakly zygomorphic and persistent. Known from northeastern Kaua'i, *Cyrtandra paliku* occurs only on Mount Namahana and is restricted to north-facing rock faces. A single population of about 70 plants occurs on vertical saturated walls.

Key words: *Cyrtandra*, Gesneriaceae, Hawaiian Islands.

The intensive collecting effort by the National Tropical Botanical Garden (NTBG) collectors during the past decade has shown that Kaua'i was one of the least effectively collected Hawaiian islands. Kaua'i also is among the most interesting, because it has the highest level of single-island endemism in the archipelago (Wagner, 1991; Sakai et al., 1995; Wagner & Funk, 1995). Especially in need of intensive survey effort was the northeastern quadrant of Kaua'i. A number of new species and many range extensions have been discovered in the past several years of work in this region of the island (see Wagner & Herbst, 1999). One of these new species is a *Cyrtandra* with dense, long shaggy pubescence and a unique habit—restricted to wet cliffs. This species was discovered by Wood during a series of surveys of this region in 1993 carried out by NTBG collaboratively with the State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife and NTBG (Lorence & Flynn, unpublished report in 1993). Reasons that it may have gone undetected prior to these recent collections are the underexploration of the region and the specialized techniques of rock-climbing used by Wood for much of the exploration of the rugged topography of this part of Kaua'i and elsewhere in the Hawaiian Islands. His collections were brought to the attention of Wagner and Lorence, who thought that it either represented a hybrid involving *C. oenobarba* H. Mann or a new species. Subsequent study of the site by Wood confirmed a uniform morphology, especially the diagnostic characters given below, among the approximately 70 individuals at this site. Natural regeneration has been observed at this site, although no additional populations have been located. Thus, we concluded that the plants represented a new species apparently restricted to a single wet cliff face. The site was visited again several times by Wood to ascertain the extent of the distribution and the total number of individuals of this distinctive new species. The additional fieldwork also was done to gather more specimens, data, and to take David Liittschwager and Susan Middleton to the site to photograph the species.

Cyrtandra paliku W. L. Wagner, K. R. Wood & Lorence, sp. nov. TYPE: Hawaiian Islands (U.S.A.). Kaua'i: border of Kawaihau and Hanalei Districts, Makaleha Mountains, slopes below Kekoiki, N-facing cliffs, seeping basalt rock face [22°08′58″N, 159°25′22″W], with *Selaginella arbuscula* (Kaulfuss) Spring, 3 populations, approximately 50 plants, in *Metrosideros-Dicranopteris* lowland wet forest with *Gunnera, Anoectochilus, Cyanea hirtella* (H. Mann) Hillebrand, *C. fissa* (H. Mann) Hillebrand, *Cyrtandra heinrichii* H. St. John, *Pipturus, Sadleria squarrosa* (Gaudichaud-Beaupré) T. Moore, *S. pallida* Hooker & Arnott; threats [include] *Rubus rosifolius* Sm., *Paspalum conjugatum* Bergius, landslides, 800–850 m, 9 Feb. 1993, *K. R. Wood 2353* (holotype, PTBG; isotypes, BISH, US). Figures 1–3.

Figure 1. *Cyrtandra paliku* W. L. Wagner, K. R. Wood & Lorence. Photographs by David Liittschwager and Susan Middleton. —(Left). Habit, showing inflorescence. —(Right). Leaf, showing shaggy reddish brown villous petiole.

Figure 2. *Cyrtandra paliku*. Photographs by David Liittschwager and Susan Middleton. —(Left). Corolla. —b. Inflorescence, showing calyx configuration post-anthesis.

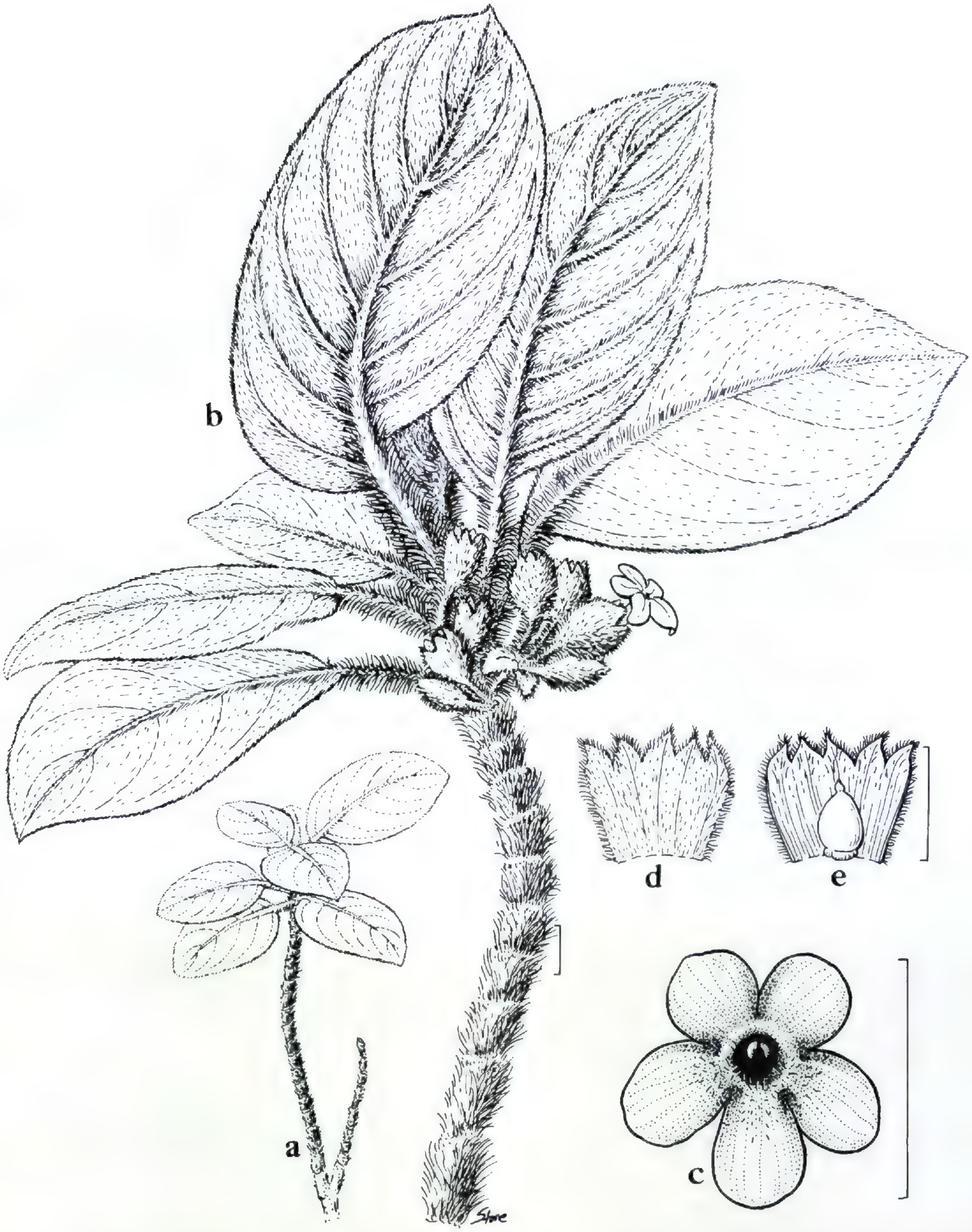


Figure 3. *Cyrtandra paliku.*—a. Habit. —b. Leafy flowering stem. —c. Corolla at anthesis, front view. —d. Opened calyx, external view. —e. Opened calyx, internal view showing ovary. [a from slide taken at type locality; b, d, e from *Wood 2855*; c from *Wood 7307.* Scale bar 1 cm in b, 1.8 cm in c, 1.5 cm in d and e.]

Species *Cyrtandrae oenobarbae* affinis, sed caulibus crassioribus villosis ex trichomatibus atrobrunneis vel castaneis 3–5 mm longis uniformiter foliarum petiolis villosis laminis basi inaequilateralibus; calyce viridi pallido vix zygomorpho persistenti differt.

Subshrub, 30–75 cm, 2- to 5-branched from base, each major stem erect, unbranched or vigorous plants with 2 or 3 additional branchlets each up to ca. 25 cm long, conspicuously shaggy villous

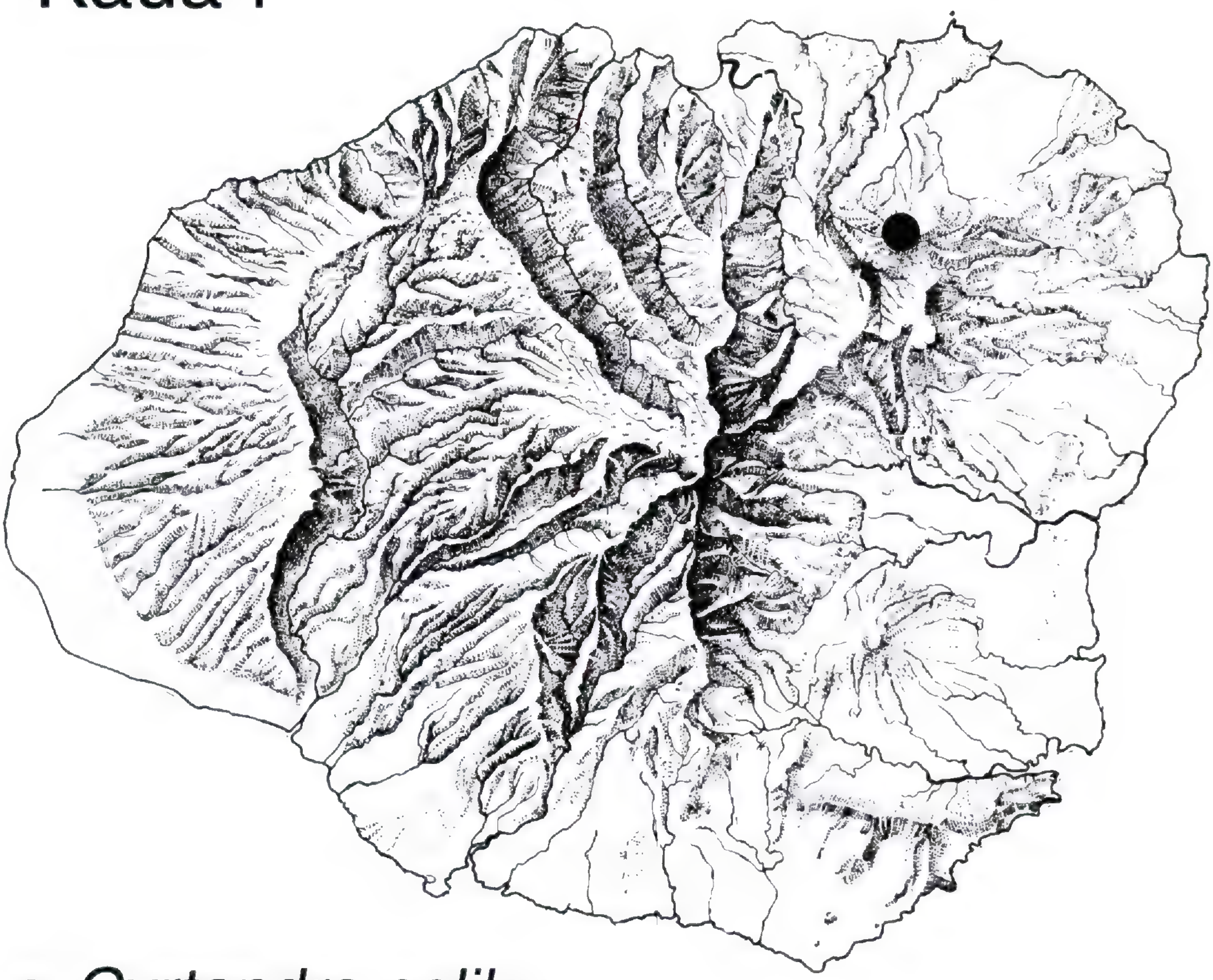


Figure 4. *Cyrtandra paliku*. Location of single known population on the island of Kaua'i.

with dark reddish brown trichomes 3–5 mm long; stems erect, thick, 6–8 mm diam., prominently ringed with leaf scars, densely shaggy long-villous. Leaves opposite, clustered at upper 3 to 7 nodes, thick, those of a pair usually unequal, one 30–50% larger than the other, the blades strongly asymmetrical, usually falcate, elliptic to oblanceolate, 7–18 × 4.5–9 cm, upper surface moderately villous, lower surface moderately long-villous, densely so along the veins, the hairs longer and more conspicuous toward the base, margins finely crenate-serrulate, the teeth widely spaced, apex acuminate, base attenuate to cuneate, inequilateral, one side (2–)10–25 mm shorter, petioles 2.5–4(–7) cm long, densely shaggy long-villous. Flowers (1 to)7 to 9 in cymes with 2 orders of branching, internodes, peduncle, and pedicels densely long-villous, peduncles 8–20 mm long, pedicels 11–15 mm long, lowermost bracts 4–10 mm long, ovate, usually obscured by the long-villous pubescence. Calyx weakly zygomorphic, pale green, ellipsoid, 12–17 mm long, cleft to 1/3 its length, glabrous internally except a few hairs on the distal portion of the lobes, villous externally, persistent after anthesis, the tube 7–10 mm long, the lobes 5–7 mm long, triangular, slightly asymmetrical. Corolla white, the tube narrowly funnelform, slightly curved upward, 14–15 mm long, glabrous externally, glandular-puberulent internally on lobes and around throat, upper 2 lobes 5–10 mm long, lateral 2 lobes 8–12 mm long, lowermost lobe 8–12 mm long, ovate, subequal to slightly longer than the other 4 lobes. Ovary glabrous. Berries not seen, but immature fruit ca. 10 mm long, ellipsoid, glabrous. Seeds not seen.

Distribution and phenology (Fig. 4). Known only from the north-facing wet cliffs of Kekoiki in the Makaleha Mountains of northeastern Kauai, Hawaiian Islands. *Cyrtandra paliku* ranges in elevation from 800 to 850 m, and occurs only on the

Kekoiki summit area of Mount Namahana, where it is restricted to shaded north-facing basalt rock faces, which are windswept and often mist-shrouded. A single population of about 70 plants is known on vertical saturated walls with *Selaginella arbuscula.* This population extends for 0.1 km surrounded by patches of lowland wet forest. Flowering has been observed during February of 1993 and May of 1998. Fruits have been observed during November of 1993. Dominant tree species in this region include *Metrosideros polymorpha* Gaudichaud-Beaupré var. *glaberrima* (H. Léveillé) H. St. John, *M. polymorpha* Gaudichaud-Beaupré var. *dieteri* J. Wyndham Dawson & Stemmermann, and *Cheirodendron fauriei* Hochreutiner. Associated understory trees and shrubs include *Broussaisia arguta* Gaudichaud-Beaupré, *Dubautia knudsenii* Hillebrand, *Perrottetia sandwicensis* A. Gray, *Hedyotis terminalis* (Hooker & Arnott) W. L. Wagner & Herbst, *Hedyotis tryblium* Herbst & W. L. Wagner, *Freycinetia arborea* Gaudichaud-Beaupré, and *Lobelia hypoleuca* Hillebrand. Additional associates include the herbaceous *Peperomia hesperomannii* Wawra and pteridophytes such as *Dicranopteris linearis* (Burman f.) Underwood f., *Selaginella arbuscula, Sadleria pallida,* and *S. squarrosa. Machaerina angustifolia* (Gaudichaud-Beaupré) T. Koyama is the dominant sedge of this region. Major threats to *Cyrtandra paliku* include invasive introduced weeds such as *Clidemia hirta* (L.) D. Don, *Paspalum conjugatum,* and *Rubus rosifolius,* along with landslides, which are not uncommon along steep, wet-forested slopes and cliffs, especially during intense tropical storms.

Etymology. The specific epithet is the Hawaiian word *paliku,* meaning vertical cliff. It is a reference to the steep wet cliffs to which *Cyrtandra paliku* is restricted.

Discussion. Cyrtandra paliku is a member of *Cyrtandra* sect. *Verticillatae* in the classification of Wagner et al. (1990). It differs from other species of *Cyrtandra* in several characters, primarily in its distinctive shaggy villous pubescence of long dark reddish brown hairs, strongly asymmetrical leaf bases, and the weakly zygomorphic persistent calyx. It is also one of only two species in the Hawaiian Islands with a nearly herbaceous habit. Generally species of the genus in the Hawaiian Islands are 1–6 m tall with softly woody stems, but herbaceous *C. oenobarba* is usually nearly decumbent, and *C. paliku,* while more upright, has stems 30–75 cm tall. These two species differ from one another in several characteristics that had led us to first suspect hybridization. First, the leaves of *C. paliku* are thicker and have shorter petioles 2.5–4(–7) cm long, pedicels 11–15 mm long, calyx weakly zygomorphic, persistent after anthesis, cleft to ⅓ its length, glabrous internally except at the apex of the lobes, the tube 7–10 mm long, the lobes 5–7 mm long, well separated in anthesis vs. in *C. oenobarba* petioles 2.5–13 cm long, pedicels 3–8 mm long, calyx strongly zygomorphic, deciduous after anthesis, cleft ⅓–½ its length, glabrous internally, the tube 10–18 mm long, the upper 3 lobes 7–17 mm long and the lower 2 lobes 6–16 mm long and tardily separating. The plants we describe here as *C. paliku* represent a distinctive reproductively stable species, although there is the possibility that it may have been formed by hybridization. The weakly zygomorphic calyx that is persistent and with short similar lobes that are well separated in anthesis suggests a possible hybrid origin. In fact, these same characters make *C. paliku* somewhat anomalous in *Cyrtandra* sect. *Verticillatae,* all members of which other than *C. paliku* have a strongly zygomorphic calyx that is quickly deciduous after anthesis.

If a hybrid origin is a possibility, which would be the putative parents? Certainly, *Cyrtandra oenobarba* would be one of them because of its similar subherbaceous habit, long dark reddish brown pubescence, and similar flowers. *Cyrtandra paliku* grows with or nearby several other species of *Cyrtandra,* including *C. heinrichii, C. kamoolaensis* H. St. John, *C. kealiae* Wawra subsp. *kealiae, C. longifolia* (Wawra) Hillebrand ex C. B. Clarke, *C. paludosa* Gaudichaud-Beaupré, *C. pickeringii* A. Gray, and *C. wainihaensis* H. Léveillé. In the same general vicinity, hybrids were noted by Lorence and Wood in the following two combinations: *C. longifolia* × *C. heinrichii* and *C. pickeringii* × *C. kealiae* subsp. *kealiae.* Neither of these have morphology at all similar to *C. paliku.* If *C. paliku* is derived via hybridization between *C. oenobarba* and another species, we would expect the other parent to contribute to the divergent features of *C. paliku.* From the above comparison between *C. paliku* and *C. oenobarba,* we would anticipate the other parent to possibly contribute shorter petioles, longer pedicels, persistent calyx, a weakly zygomorphic calyx with the inner surface pubescent toward the lobes, well-separated calyx lobes at anthesis, and a shorter calyx. None of the species observed growing in the general vicinity of *C. paliku* at the present time have all of these characteristics. From the above list, five of the seven species have at least some of the criteria for the second parent: *C. heinrichii, C. kamoolaensis, C. kealiae* subsp. *kealiae, C. pickeringii,* and *C. wainihaensis. Cyrtandra kamoolaensis* would seem unlikely, as it has long foliaceous calyx

lobes. Similarly, the calyx of *C. kealiae* subsp. *kealiae* is too large, but many of the other features make it a possible candidate. The other two possible candidates are *C. pickeringii* or possibly *C. wainihaensis*, although neither of these has all of the characteristics listed above either. Field studies and use of molecular markers may address this hybrid hypothesis and the actual parentage if an appropriate set of species-specific markers could be found. The genus *Cyrtandra* is very complex in the Hawaiian Islands with 514 names described for 58 currently recognized species (Wagner et al., 1999). Much of the variation exhibited by the genus in the Hawaiian Islands is the result of extensive sympatry and resultant hybridization (Wagner et al., 1990). To date, over 80 hybrid combinations have been identified (Wagner et al., 1990; Wagner, unpublished data). Recent use of RAPD markers has confirmed a number of the morphologically based hybrid hypotheses (Smith et al., 1996), including another Hawaiian species, *C. kaulantha* H. St. John & Storey, hypothesized to be of hybrid origin.

Paratypes. HAWAIIAN ISLANDS (U.S.A.). **Kaua'i:** border of Kawaihau and Hanalei Districts, Makaleha Mountains north-facing steep slopes below Kekoiki, 800–850 m, 10 Nov. 1993, *Wood 2855* (PTBG, US); 2750 ft. (838 m), 22°09′00″N, 159°25′39″W, 10 Aug. 1999, *Wood et al. 7951* (PTBG), *Wood et al. 7952* (PTBG).

Acknowledgments. We thank the State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, for support during the initial survey, and the Kaua'i District office for granting permission to conduct fieldwork in the Makaleha Mountains. We extend our gratitude to Anna Stone for preparing the line drawing and to David Liittschwager and Susan Middleton for permission to use several of their excellent photographs in this paper. We appreciate the review comments by James Smith, Laurence Skog, and an anonymous reviewer.

Literature Cited

Sakai, A. K., W. L. Wagner, D. M. Ferguson & D. R. Herbst. 1995. Origins of dioecy in the flowering plants of the Hawaiian Islands. Ecology 76: 2517–2529.

Smith, J. F., C. C. Burke & W. L. Wagner. 1996 [1997]. Interspecific hybridization in natural populations of *Cyrtandra* (Gesneriaceae) on the Hawaiian Islands: Evidence from RAPD markers. Pl. Syst. Evol. 200: 61–77.

Wagner, W. L. 1991. Evolution of waif floras: A comparison of the Hawaiian and Marquesan archipelagos. *In* E. C. Dudley (editor), The Unity of Evolutionary Biology, the Proceedings of the Fourth International Congress of Systematics and Evolutionary Biology. Dioscorides Press, Portland, Oregon.

——— & V. A. Funk (editors). 1995. Hawaiian Biogeography: Evolution on a Hot Spot Archipelago. Smithsonian Institution Press, Washington, D.C.

——— & D. R. Herbst. 1999. Supplement to the Manual of the flowering plants of Hawai'i. Pp. 1855–1918 *in* W. L. Wagner, D. R. Herbst & S. H. Sohmer, Manual of the Flowering Plants of Hawai'i, Revised Ed. Univ. Hawaii Press, Honolulu. 2 vols. [Bishop Museum Special Publication 97.]

———, ——— & S. H. Sohmer. 1990. Manual of the Flowering Plants of Hawai'i. Univ. Hawaii Press and Bishop Museum Press, Honolulu. 2 vols. [Bishop Museum Special Publication 83.]

———, ——— & ———. 1999. Manual of the Flowering Plants of Hawai'i, Revised Edition with Supplement by W. L. Wagner & D. R. Herbst, pp. 1855–1918. Univ. Hawaii Press, Honolulu. 2 vols. [Bishop Museum Special Publication 97.]

Four New Combinations in the Genus *Nasa* (Loasaceae)

Maximilian Weigend

Lewis B. and Dorothy Cullman Program for Molecular Systematics Studies, New York Botanical Garden, 200th St. & Southern Blvd., Bronx, New York 10458, U.S.A. Current address: Institut fuer Biologie–Systematische Botanik und Pflanzengeographie, Freie Universitaet Berlin, Altensteinstr. 6, D-14195 Berlin, Germany

ABSTRACT. New combinations for four South and Central American species formerly assigned to *Loasa* are proposed: *Nasa lindeniana* (Urban & Gilg) Weigend and *Nasa venezuelensis* (Steyermark) Weigend from Venezuela, *Nasa speciosa* (Donnell Smith) Weigend from Costa Rica and Panama, and *Nasa herzogii* (Urban & Gilg) Weigend from Bolivia.

Key words: Bolivia, Central America, Costa Rica, *Loasa*, Loasaceae, *Nasa*, Panama, South America, Venezuela.

The genus *Nasa* Weigend was established to accommodate the major part of the southern and central Andean species formerly included in the genus *Loasa* Adanson and now contains ca. 100 species, distributed from southern Mexico to northern Bolivia and Chile. The genus is characterized by a suite of unique characters, most importantly by inflorescence branches with only one recaulescent bract per flower, floral scales with apical wings and dorsal sacs, and a chromosome number of $2n = 28$. The vast majority of taxa are found in Colombia (ca. 20, Weigend, in press), Ecuador (ca. 30, Weigend, 1999, 2000), and Peru (more than 40, Weigend, 1998). Only four species of *Nasa* are found exclusively outside these three countries, and the new combinations required are here provided.

1. **Nasa herzogii** (Urban & Gilg) Weigend, comb. nov. Basionym: *Loasa herzogii* Urban & Gilg, Meded. Rijks-Herb. Leiden 29: 57. 1916. TYPE: Bolivia. Santa Cruz: forest next to Río Tocoraní, 2600 m, July 1911, *T. Herzog 2277* (lectotype, selected here, L; isolectotypes, S, Z, B—photo F neg. #10195).

The holotype in Berlin is lost, and the Leiden specimen is here chosen as the lectotype. *Nasa herzogii* is one of two species of the genus found in Bolivia. It is a subperennial or subshrub from the cloud forest in Santa Cruz with large, widely ovate leaves (width > 7 cm) and ovoid capsules. The only other species of *Nasa* in the country is the annual *N. ferruginea* from the Altiplano (Lake Titicaca area) with considerably smaller, ovate leaves (diam. < 5 cm) and clavate capsules.

2. **Nasa lindeniana** (Urban & Gilg) Weigend, comb. nov. Basionym: *Loasa lindeniana* Urban & Gilg, Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 76: 194. 1900. TYPE: Venezuela. Mérida: Sierra Nevada near Mérida, 3000 m, 1842, *J. Linden 405* (lectotype, selected here, BM; isolectotypes, CGE, K, OXF, P, W). SYNTYPES: same locality, *N. Funck & L. J. Schlim 1045* (BM, G, P, W, fragment F).

Urban and Gilg (1900) cited two different collections in their protologue: *Linden 405* and *Funk & Schlim 1045*. The Linden collection is here chosen as lectotype as it includes the better and more complete specimens. *Nasa lindeniana* is unique in the genus in its possession of two inflexed (instead of erect) apical wings on its floral scales, and is easily distinguished from the other species of the genus present in Venezuela (see *Nasa venezuelensis* for a comparison).

3. **Nasa speciosa** (Donnell Smith) Weigend, comb. nov. Basionym: *Nasa speciosa* Donnell Smith, Bot. Gaz. (Crawfordsville) 23: 8. 1897. TYPE: Costa Rica. Cartago: Volcán Turrialba, 7500 ft., Jan. 1889, *H. F. Pittier 875* (lectotype, selected here, CR not seen; isolectotype, BR). SYNTYPE: same locality, Mar. 1894, *F. N. Cox 4812* (US).

Donnell Smith (1897) cited two collections in the protologue of *Loasa speciosa* and specifically stated that he had seen the Costa Rican National Herbarium (CR) specimen of *Pittier 875;* he also cited *Cox 4812*, but without indicating in which herbarium he had seen a specimen of this collection. It therefore seems adequate to select the one specimen that

the author certainly had seen when describing the plant (i.e., *Pittier 875* in CR) as the lectotype. *Nasa speciosa* and *N. triphylla* (Jussieu) Weigend are the only two species of *Nasa* in Central America: *N. triphylla* is an annual herb with white, spreading petals and triangular-ovate, bipinnatisect to bipinnate leaves (Dostert & Weigend, 1999). *Nasa speciosa* is a shrub with orange, campanulate corollas and widely ovate to pentagonal leaves with 3–4 widely triangular, very shallow leaf lobes on each side. It is only found in Panama and Costa Rica, whereas *Nasa triphylla* ranges from southern Mexico to northern Peru.

4. Nasa venezuelensis (Steyermark) Weigend, comb. nov. Basionym: *Caiophora venezuelensis* Steyermark, Fieldiana, Bot. 28(2): 414. 1952. *Loasa venezuelensis* (Steyermark) Weigend, Sendtnera 3: 234. 1996. TYPE: Venezuela. Mérida: Mérida, La Isla at Tabay, 2280–2745 m, 18 May 1944, *J. A. Steyermark 56594* (holotype, F).

Caiophora larensis Steyermark, Fieldiana, Bot. 28(2): 412. 1952. TYPE: Venezuela. Lara: between Buenos Aires & El Callado valley, above Humocaro Alto, 2285–2740 m, 12 Jan. 1944, *J. A. Steyermark 55528* (holotype, F).

Nasa venezuelensis is easily distinguished from the other two species of *Nasa* found in Venezuela: It differs from *Nasa triphylla* in having orange petals up to 5 cm long (vs. white petals up to 1.5 cm long) and uniformly yellow floral scales without a dorsal callus (vs. floral scales with horizontal bands in red, yellow, and white with a dorsal callus). It differs from *Nasa lindeniana* in having a spreading corolla with membranaceous, apically acuminate, and deeply boat-shaped petals with a basal claw (vs. a campanulate corolla with carnose, apically rounded, and nearly planar petals without claw), nectar scales with erect apical wings (vs. inflexed apical wings), and a triangular, bipinnate to bipinnatisect lamina (vs. a widely ovate to pentagonal lamina with shallow lobes). *Caiophora larensis* differs very slightly in leaf indument, but it is so far only known from the very poorly preserved type specimen (Weigend, 1996) and is here considered as a synonym of *Nasa venezuelensis.*

Acknowledgments. I express my sincere gratitutude to the directors of the herbaria BM, BR, CGE, L, F, G, K, OXF, P, US, and W for loans of material and to the Studienstiftung des Deutschen Volkes, Deutsche Forschungsgemeinschaft, Deutscher Akademischer Austauschdienst, and the Lewis B. and Dorothy Cullman Foundation for providing funds at various stages of this project. I am grateful to two anonymous reviewers for valuable comments on the manuscript.

Literature Cited

Donnell Smith, J. 1897. Undescribed plants from Guatemala and other Central American Republics VII. Bot. Gaz. (Crawfordsville) 23: 1–14.

Dostert, N. & M. Weigend. 1999. A synopsis of the *Nasa triphylla* complex (Loasaceae), including some new species and subspecies. Harvard Pap. Bot. 4: 439–467.

Urban, I. & W. Gilg. 1900. Monographia Loasacearum. Nova Acta Acad. Caes. Leop.-Carol. German. Nat. Cur. 76(1): 1–368.

Weigend, M. 1996. Notes on Loasa I–III. Sendtnera 3: 219–253.

———. 1998. *Nasa* y *Presliophytum*: Los nombres y sus tipos en los nuevos géneros segregados de *Loasa* Juss. *sensu* Urb. & Gilg en el Perú. Arnaldoa V(2): 159–170.

———. 1999. Loasaceae. *In* P. M. Jørgensen & S. León-Yánez (editors), Checklist of the Vascular Plants of Ecuador. Monogr. Syst. Bot. Missouri Bot. Gard. 75: 954–955.

———. 2000. No. 132. Loasaceae. Pp. 1–92 *in* L. Andersson & G. Harling (editors), Flora of Ecuador Vol. 64.

———. In Press. Loasaceae. *In* R. Bernal (editor), Flora de Colombia.

Volume 11, Number 1, pp. 1–154 of NOVON was published on 30 April 2001.

Volume 11
Number 2
2001

NOVON

Three New Infraspecific Taxa of *Manihot* (Euphorbiaceae) from the Brazilian Neotropics

Antonio C. Allem

Embrapa Recursos Genéticos e Biotecnologia, C.P. 02372, 70849-970 Brasília, DF, Brasil

ABSTRACT. *Manihot caerulescens* subsp. *laevis, M. carthaginensis* subsp. *hahnii,* and *M. dichotoma* var. *undulata,* all three assigned herein to section *Glaziovianae,* are described and illustrated. *Manihot carthaginensis* subsp. *hahnii* appears endemic to northern and northwestern portions of Minas Gerais. *Manihot dichotoma* var. *undulata* and *M. caerulescens* subsp. *laevis* are endemic to Brazil's northeastern semiarid phytogeographic region known as caatinga. A new combination is provided for *M. glaziovii,* which is submerged as a subspecies in the expanded circumscription of *M. carthaginensis.*

Key words: Brazil, Euphorbiaceae, *Manihot,* Neotropics.

Recent taxonomic studies of the genus *Manihot* in Brazil have disclosed a number of new species and taxa (Allem, 1989a, 1989b, 1999). In the last monograph (Rogers & Appan, 1973) 98 species were recognized, all confined to the New World. The economic importance of the genus resides in the root crop cassava (*Manihot esculenta* Crantz subsp. *esculenta*), a major staple for rural and indigenous populations in much of the Neotropics and Paleotropics. Rogers and Appan (1973) assigned ca. 80 species to Brazil. Recent reassessment of the Brazilian species yielded a more reasonable estimate of 45 species (Allem, 2001). However, at least two more new species will join the Brazilian taxa in the near future. *Manihot* is a difficult genus on account of the extensive infraspecific vegetative and floral variation; this explains the high levels of inflation recorded for the genus (e.g., Rogers & Appan (1973) recognized 98 species out of 170 published prior to 1973). Croizat (1943) was of the opinion that the sections created by Pax (1910) were unworkable from a practical standpoint. Likewise, many of the sections recognized by Rogers and Appan (1973) were considered too artificial to serve any practical purpose by Allem (2001). Sixteen groups of related taxa were proposed, with 45 species; group VI in particular, the *Manihot esculenta* group, has already been extensively studied using genetic markers, and the molecular results have coincided with the phenetic classification (a comprehensive review of this bibliography appears in Allem, 2001). Some authors (e.g., Second et al., 1997) have noted the large discrepancies existing between Rogers and Appan's (1973) treatment and Allem's more cohesive delimitations of species.

During preparation of a treatment on section *Glaziovianae* Pax emend. Rogers & Appan, a group largely confined to caatinga vegetation in northeastern Brazil, it was necessary to describe three new taxa to document infraspecific variation: *Manihot caerulescens* subsp. *laevis, M. carthaginensis* subsp. *hahnii,* and *M. dichotoma* var. *undulata.* In addition, because the names *M. carthaginensis* and *M. glaziovii* represent the same variable and widespread taxon within *Manihot,* a new combination and status are provided for the latter.

A key to all species and infraspecific taxa of the revised section *Glaziovianae* will appear in a forthcoming article by the author.

Materials and Methods

In this treatment the ranks "subspecies" and "variety" correspond to allopatry and sympatry, re-

spectively, in *Manihot.* Thus, because *M. carthaginensis* was described from Colombia and *M. glaziovii* from Brazil, this author chose the category subspecies for them. The reasoning for *M. caerulescens* followed a similar pattern. Rogers and Appan (1973) recognized three subspecies for this species, with abundant synonyms. This author proposes only two taxa, subspecies *caerulescens* and subspecies *laevis:* subspecies *laevis* is known only from southwestern Bahia, while subspecies *caerulescens* thrives in much of neotropical Brazil and Paraguay. *Manihot dichotoma* var. *dichotoma* and variety *undulata* overlap to a large degree in Bahia and were thus conferred varietal status.

Description of fruit dimensions follows Rogers and Appan's (1973) treatment. Because precise lengths and widths are often difficult to delimit because of the shape of the fruit, the authors aptly chose to use the expressions "from base to apex" [and] "wide."

Manihot sect. **Glaziovianae** Pax emend. Rogers & Appan, Fl. Neotr. 13: 175. 1973. TYPE: *Manihot carthaginensis* (Jacquin) Mueller Argoviensis, in DC., Prod. xv. II. 1073. 1866.

Manihot sect. *Carthaginenses* Rogers & Appan, Fl. Neotr. 13: 112. 1973. Syn. nov.

Tall shrubs to small trees; lamina coriaceous or chartaceous, deeply lobed, lobes variously shaped but not linear. Inflorescence a raceme, less commonly a panicle. Floral bracts and bracteoles setaceous to foliaceous, margins dentate, fimbriate, or entire.

1a. Manihot caerulescens Pohl emend. Rogers & Appan, Fl. Neotr. 13: 242. 1973. Basionym: *Manihot caerulescens* Pohl, Pl. Bras. Ic. et Descr. 1: 56. 1827. TYPE: "Brasil, Bahia, Malhada ad Sincorá," *Martius s.n.*, ca. 1818 (syntypes, G, L, M).

Manihot heptaphylla Ule, Notizbl. Bot. Gart. Berlin 5(41): 2. 1908. Syn. nov. TYPE: "Brasil, Bahia, serra de São Inácio próximo ao rio São Francisco," Feb. 1907, *Ule 7206* (syntypes, G—2 sheets, K photo, L not seen, MG not seen, UC not seen, US not seen).

1b. Manihot caerulescens Pohl subsp. **laevis** Allem, subsp. nov. TYPE: Brazil. Bahia: Município de Xique-Xique, 30 km SW of city along dirt road to Santo Inácio, ca. 11°05′S, 42°45′W, 580 m, glabrous treelet, 6 m tall, with flowers and fruits, 11 Dec. 1987, *A. Allem & W. Werneck 3740* (holotype, CEN; isotypes, G, K, MBM, MO). Figure 1.

A *M. caerulescenti* Pohl fructibus superficie omnino laevi differt.

Treelet 4–10 m tall, glabrous in vegetative and floral parts, highly branched. Stems with copious white latex exudate. Leaves alternate; stipules conspicuous, margins laciniate to serrate; petioles 4–15(–25) cm long, cylindric, greenish, eventually tinted with red; petiole basally attached to lamina; upper lamina deep green, shiny, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblanceolate, 3–12(–15) × 2–3(–5) cm, often pandurate, lamina edges entire or slightly undulate, apex acuminate or cuspidate; outermost lobes smaller than median lobes. Monoecious inflorescence, terminal, glabrous, lax raceme, 3–8(–12) cm long; mature male floral bracts large and showy, yellowish, rather persistent, broadly ovate to lanceolate, margins entire or slightly toothed at the apex, 5–12(–20) × 3–8(–14) mm; bracteoles half this size. Mature male buds lanceolate, at times somewhat constricted at mid level, attenuated at apex. Male flower: pedicel 4–8(–10) mm long; flower 9–15 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc fleshy and conspicuous. Female flower: restricted to the lowermost part of the bisexual inflorescence and at times in clusters of 2 to 5 solitary flowers in the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–15 mm long, cleft to the base into 5 lobes, tepals broadly triangular, glabrous externally; ovary cylindric to lanceolate, glaucous, smooth, glabrous, stigma fimbriate, glandular disc conspicuous. Mature fruit very large compared to the average capsular fruit of the genus, 20–25(–30) mm from base to apex, approximately the same width (vs. the average of 10–13 mm long from base to apex, 8–10 mm wide), baccate and indehiscent, rounded, smooth, glabrous, green in fresh material. Mature seed plump, ca. 12–14 × 8–12 mm, crotonoid, cylindric, mottled, caruncle minute.

Distribution. *Manihot caerulescens* subsp. *laevis* is endemic to a few southwestern municipalities of Bahia.

Phenology. This subspecies flowers in late October and sets mature fruits from April through June.

The subspecific name refers to the unique wingless character of the fruit surface.

Manihot caerulescens is the only species of *Manihot* known to range across three of the largest Brazilian biomes: cerrados of the Brazilian Amazon, cerrado in central Brazil, and caatinga. The species

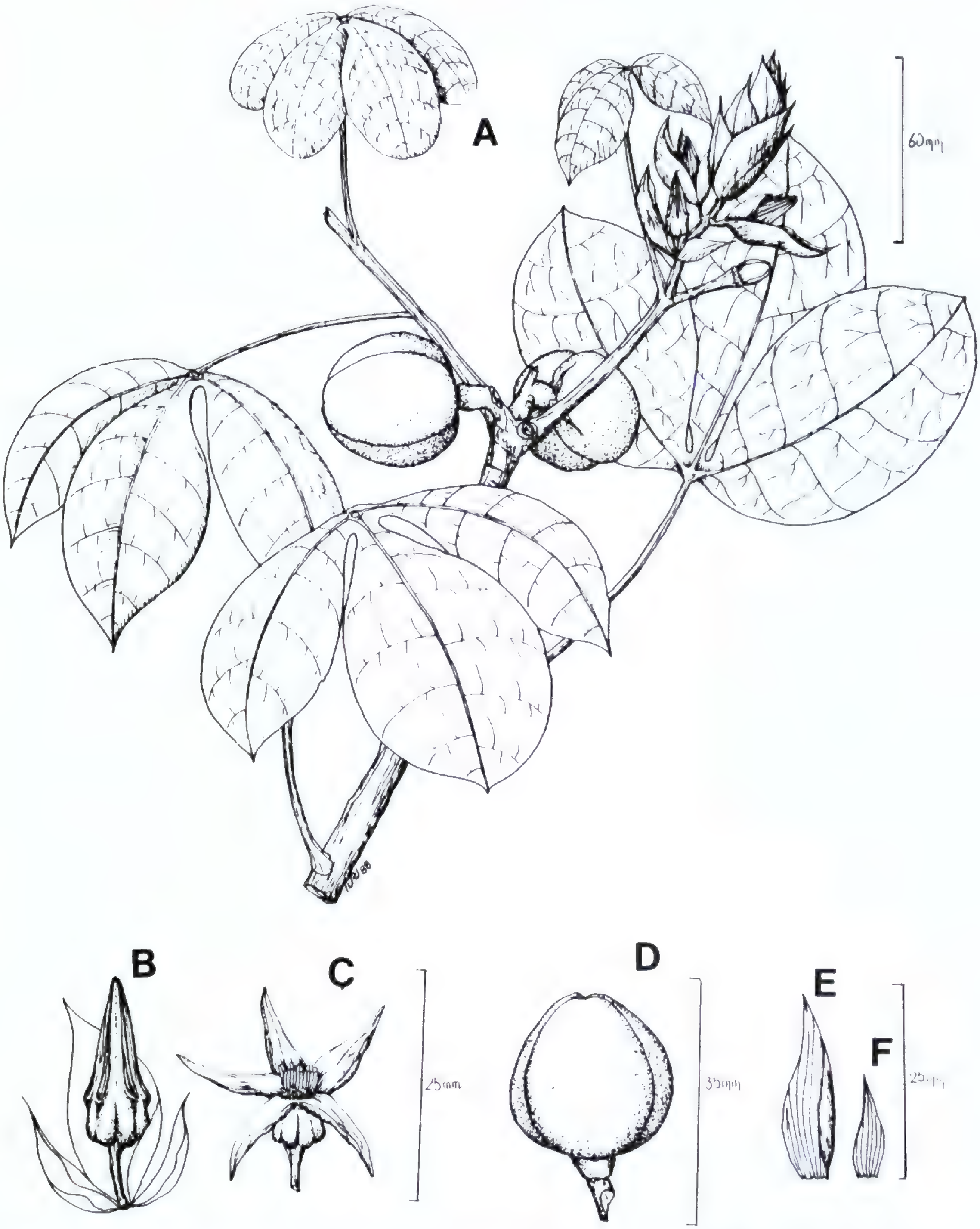


Figure 1. *Manihot caerulescens* subsp. *laevis* Allem (drawn from holotype, *Allem & Werneck 3740*). —A. Flowering branch with foliaceous floral bracts and smooth fruits. —B. Mature male bud subtended by the floral bract and two bracteoles. —C. Male flower (same scale bar for B). —D. Indehiscent, smooth, glabrous fruit. —E. Mature male floral bract. —F. Mature male floral bracteole.

has also been recorded for Paraguay. Despite such a broad distribution, the species morphology is relatively uniform except for the shape and ornamentation of the fruit. The species was exploited as a minor source of latex during the rubber-tapping economic boom at the beginning of the 20th century by tens of thousands of families from Brazil's northeastern region (Zehntner, 1914). It was locally known to rubber-tappers as "maniçoba-do-piauí." Rogers and Appan (1973: 238) created a special

section (*Caerulescentes*) to accommodate only this species, but this is not warranted herein. In addition to *M. caerulescens*, Rogers and Appan (1973: 242) recognized two further subspecies, *M. caerulescens* subsp. *paraensis* (Mueller Argoviensis) Rogers & Appan and subspecies *macrantha* (Pax & Hoffmann) Rogers & Appan. These two taxa need additional studies to support their recognition.

The placement of *M. heptaphylla* under the synonymy of subspecies *caerulescens* was empirically decided in 1979 (Allem, 1979a) after seeing the accurate drawing of the fruit of the type specimen redrawn from the original by Pax (1910: fig. 15b). The fruit shown is one of the variants displayed by subspecies *caerulescens*; in this case, the type has slim ornamental wings but still a conic shape. More recently, examination of the phototype of the syntype of *M. heptaphylla* (*Ule 7206*, K) shows a plant bearing a compact raceme with foliaceous floral bracts, but no fruits are present and fruits are critical to separate the two varieties. The syntype *Ule 7206* at G was examined by Rogers and Appan (1973) and appears as their figure 122; this plant is different from the Kew syntype in that this particular branch bears two young conically shaped fruits, a trait associated with subspecies *caerulescens*. *Manihot caerulescens* subsp. *laevis* is vegetatively indistinguishable from subspecies *caerulescens*; in addition, it shows the same type of inflorescence with large and showy foliaceous floral bracts. As a distinctive character, however, the new variety shows conspicuous, unusually large, completely smooth and rounded fruits. Subspecies *laevis* is endemic to a few southwestern municipalities in Bahia and prefers dry semi-xeric habitats, thriving particularly well on rocky outcrops and alongside boulders.

Manihot caerulescens belongs to section *Glaziovianae* on the basis of its geography and ecology. The baccate fruit of *M. caerulescens* establishes a transitional link between this species and the group of Amazonian species (e.g., *M. baccata* Allem, *M. quinquepartita* Huber ex Rogers & Appan) also characterized by baccate fruits (Allem, 1999). The fruit of subspecies *caerulescens* is characterized in the main by its conspicuously triangular-conic shape with slightly to strongly developed wings (the latter condition prevails). *Manihot caerulescens* is unique within section *Glaziovianae* because of its baccate indehiscent fruits. All other species of the section have capsular fruits.

The distributional range of section *Glaziovianae* was in northeastern Brazil according to Rogers and Appan (1973). However, these authors do not recognize section *Caerulescentes* Rogers & Appan (stated above). By transferring its species into section *Glaziovianae*, the geographic range of this section is expanded considerably. *Manihot caerulescens* ranges southward to the cerrados of the state of São Paulo and north well into the cerrados of the state of Pará in Amazonia (Allem, 1994). This demonstrates the difficulty in defining sections that rely heavily on geographical distribution to delimit them, as they may be inaccurate.

Paratype. BRAZIL. **Bahia:** Ibotirama, Hotel Velho Chico, cultivated in backyard by the San Francisco river, ca. 12°08′S, 43°12′W, 17 Nov. 1984, *A. Allem, G. L. Webster & W. L. Werneck 3015* (CEN).

KEY TO THE TWO BRAZILIAN SUBSPECIES OF *MANIHOT CAERULESCENS*

1a. Fruit conical, moderately to strongly winged . . . . . *M. caerulescens* subsp. *caerulescens*

1b. Fruit rounded, completely wingless . . . . . *M. caerulescens* subsp. *laevis*

2a. Manihot carthaginensis (Jacquin) Mueller Argoviensis, in DC., Prod. xv. II. 1073. 1866. Basionym: *Jatropha carthaginensis* Jacquin, Select. Stirp. Amer. Hist. 256 t. 162 f.1. 1763. TYPE: Colombia. Bolívar: Cartagena, *Jacquin s.n.* (holotype, P not seen; isotypes, F photo not seen, W). For synonymy, see Allem (1979b).

2b. Manihot carthaginensis subsp. **glaziovii** (Mueller Argoviensis) Allem, comb. et stat. nov. Basionym: *Manihot glaziovii* Mueller Argoviensis, in Martius, Fl. Bras. 11(2): 446. 1874. TYPE: Brazil. Rio de Janeiro: "environs of Rio de Janeiro," cultivated, *Glaziou 1022* (syntypes, F photo not seen, G).

Manihot johannis Pax, in Engler, Pflanzenreich IV. 147 (Heft 44): 78. 1910. Syn. nov. TYPE: Brazil. Bahia: "in sylvis catingae inter Malhada et Sincora," *Martius s.n.* (type, M not seen; G phototype, M phototype).

Manihot epruinosa Pax & Hoffmann, in Engler, Pflanzenreich IV. 147 (Heft 85): 196. 1924. Syn. nov. TYPE: Brazil. Paraiba: Acary, Mar. 1920, *Luetzelburg 12417* (syntypes, F not seen, M).

Manihot pseudoglaziovii Pax & Hoffmann, in Engler, Pflanzenreich IV. 147 (Heft 85): 196. 1924. Syn nov. TYPE: Brazil. Rio Grande do Norte: Serra Parelhas, Mar. 1920, *Luetzelburg 12888* (syntype, M).

On the basis of field experience, this author had concluded in January 1995 that *M. carthaginensis* and *M. glaziovii* are conspecific. After documenting over 15 populations of the former species along the Brazilian-Bolivian border from 1976 through 1979 and again in 1995, as well as over 40 populations of the latter in much of northeastern Brazil from

1985 on, it seemed untenable to construct workable dichotomous taxonomic keys to separate the two species. Preliminary geographical information systems (GIS) studies conducted at CIAT in 1995 indicated that *M. carthaginensis* was expected to occur in northeastern Brazil (Peter Jones, pers. comm., Nov. 1995). In addition, recent molecular studies with AFLP/RAPD markers (Second, 2000; Second & Iglesias, 2000) found a high degree of genetic relatedness between both species. In practice, this meant that the section *Carthaginenses* of Rogers and Appan (1973) was in all likelihood artificial.

The two subspecies were mainly based on geographical criteria: *M. carthaginensis* subsp. *carthaginensis* is restricted to parts of Argentina, Paraguay, Bolivia, Colombia, and Venezuela, its populations often with pandurate leaves, while *M. carthaginensis* subsp. *glaziovii* is mostly restricted to northeastern Brazil, but is also found in northeastern parts of Minas Gerais, in transitional areas with caatinga vegetation, close to the Bahian border. Its populations generally have elliptic or elliptic-lanceolate leaves, seldom pandurate. The type and place of collection of *M. pseudoglaziovii* leave no doubt that it is conspecific with *M. glaziovii.* Likewise, the type and place of collection of *M. epruinosa* suggest that it is also conspecific with *M. glaziovii.* The fact that Rogers and Appan (1973) described *M. epruinosa* as "tall shrubs to low trees, to 10 m tall" is good evidence of man's influence on the taxonomy of the genus. The shrubby habit, that most commonly found, is due to anthropogenic fires and the pruning back of plants carried out by road workers; undisturbed individuals are treelets reaching 8–11 m tall. *Manihot johannis* was placed by Rogers and Appan (1973) in their group of "species dubia." The type specimen of *M. johannis* (*Martius s.n.*, M phototype) is reduced to little more than a scrap, but the remains of a young inflorescence seem to suggest rather sessile male buds and filiform floral bracts, characters loosely associated with an *M. glaziovii* species complex. The 5 branches of the type specimen carry no leaves and on the basis of such scanty material, in addition to the geography of the species, *M. johannis* is cautiously assigned as a further synonym of *M. carthaginensis* subsp. *glaziovii.*

2c. Manihot carthaginensis subsp. **hahnii** Allem, subsp. nov. TYPE: Brazil. Minas Gerais: município de Januária, exactly 2.9 km after disembarking from the ferryboat along BR-135 Hwy. on the way to the city center, ca. 15°29′S, 44°23′W, 470 m, glabrous treelet 6 m tall, disturbed remnant of dry semi-caducifolious forest, 16 Feb. 1995, *A. Allem & V. Silva 4572* (holotype, CEN; isotypes, G, K, M, MBM, MO, NY, UB, US). Figure 2.

A *M. carthaginensi* (Jacquin) Mueller Argoviensis fructibus conspicue alatis differt.

Treelet 4–7 m tall, glabrous in vegetative and floral parts, highly branched. Stems rather blackened, twigs with copious white latex exudate. Leaves alternate; stipules conspicuous, margins laciniate; petioles 5–15(–20) cm long, cylindric, greenish, petiole basally attached; upper surface of lamina deep green, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblanceolate, occasionally pandurate, 4–12(–15) × 1–4(–6) cm, lamina edges entire or slightly undulate, apex acuminate or eventually cuspidate; outermost lobes smaller than median lobes. Monoecious terminal inflorescence, glabrous, lax raceme, 4–12(–20) cm long, occasionally panicles. Mature male floral bracts minute, inconspicuous, very early deciduous, narrowly lanceolate, 3–5(–7) mm long, 0.5–1(–1.5) mm wide, margins slightly toothed or ciliate; bracteoles half this size. Male flower: shape rather campanulate; buds compressed inward in apical third; pedicel 5–10(–12) mm long, perianth 9–13 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc conspicuous, fleshy. Female flower: restricted to the lowermost part of the inflorescence, occasionally in clusters of 2 to 5 solitary flowers in the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–12 mm long, cleft into 5 lobes, tepals broadly triangular, glabrous externally; ovary rounded, slightly to strongly winged, glabrous, stigma fimbriate, glandular disc conspicuous. Mature fruit rounded to roundish-ovate, 16–20(–22) mm from base to apex, 15–17(–20) mm wide, strongly winged (Fig. 2E), a few slightly winged, glabrous, dehiscent, green in fresh material. Mature seed plump, broadly ovate, ca. 8–10 × 6–8 mm, mottled, ecarunculate.

Distribution. *Manihot carthaginensis* subsp. *hahnii* has so far been found only in scattered forest sites in northeastern Minas Gerais.

Phenology. Like most other species in Brazil, this subspecies flowers in late October and sets fruits from January through early April.

Vernacular name. Mandioca-brava (*Ratter et al. 2633*).

It is very appropriate that this subspecies be named after Sang Ki Hahn, who, over a 22-year career span with the International Institute of Tropical Agriculture (IITA) at Ibadan in Nigeria, successfully transferred virus-resistant genes of *M. glaziovii* into commercial African cassava cultivars.

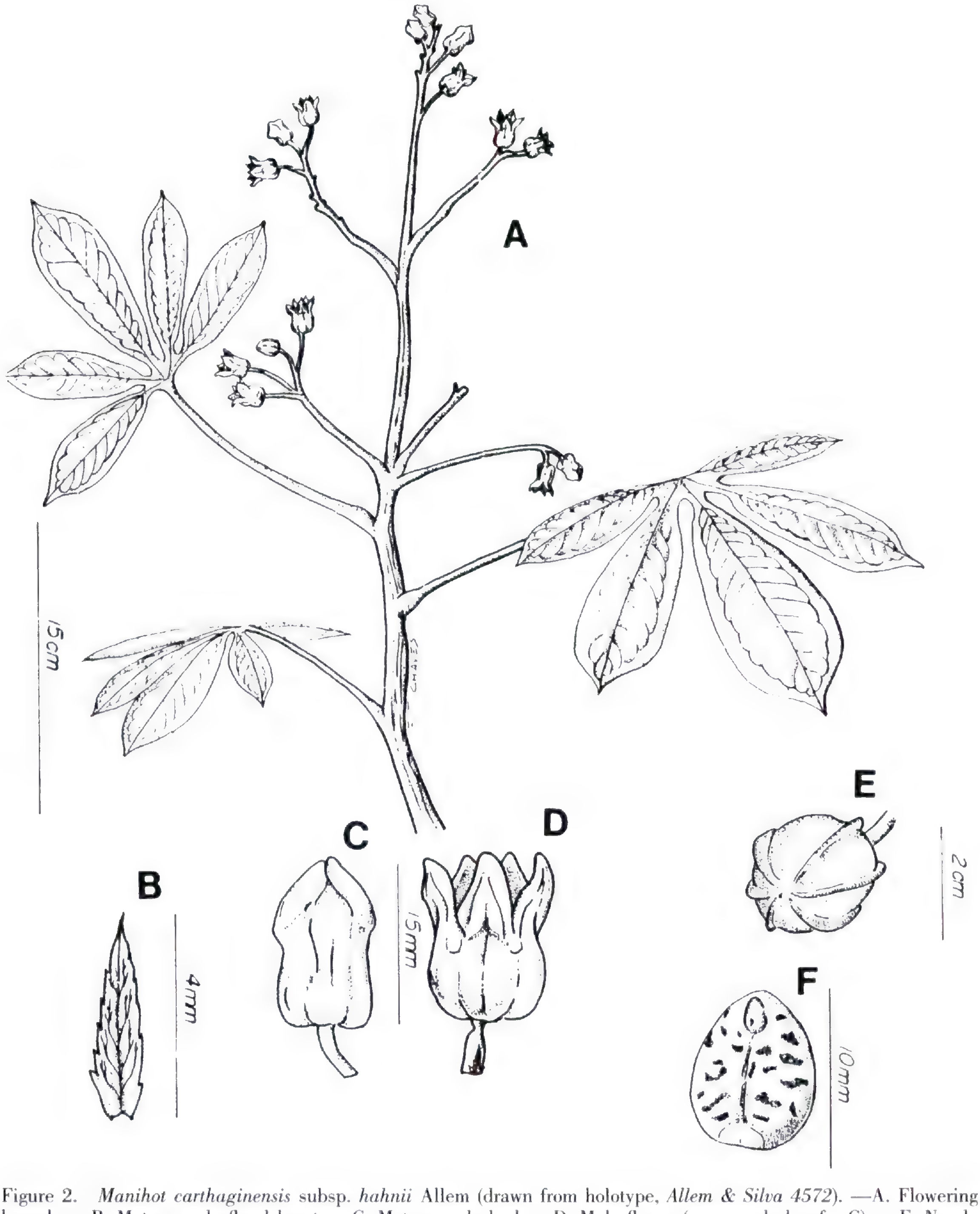


Figure 2. *Manihot carthaginensis* subsp. *hahnii* Allem (drawn from holotype, *Allem & Silva 4572*). —A. Flowering branch. —B. Mature male floral bract. —C. Mature male bud. —D. Male flower (same scale bar for C). —E. Nearly mature fruit. —F. Nearly mature seed, ventral view.

Manihot carthaginensis subsp. *hahnii* constitutes a narrow endemic in the dry semi-caducifolious forests of northwestern Minas Gerais. Its recognition as a distinct taxon is supported on geographic distinction and principally on morphology (fruit wings). Fresh mature fruits of this subspecies are slightly larger (up to 22 mm long) than those of subspecies *glaziovii* (only to 20 mm long); the seeds of both are similar in size and shape.

Paratypes. BRAZIL. **Minas Gerais:** Januária, ca. 5 km SW of Januária along BR-135 Hwy. on road to Lontra, *A. Allem & W. Werneck 3687* (CEN); ca. 31 km NE of Januária along road to Itacarambi, *A. Allem & W. Werneck 3690* (CEN), *3694* (CEN); exactly 8.3 km from old bridge

over the San Francisco river along BR-135 toward city center, *A. Allem & V. Silva 4571, 4573, 4574, 4575* (all CEN); 32.3 km NE of city along BR-135 toward Itacarambi, *A. Allem & V. Silva 4580, 4581, 4583* (all CEN); 10 km W of Januária, treelet 5 m tall on limestone cliffs, *J. A. Ratter, S. G. da Fonseca & R. A. de Castro 2633* (UB); Cardeal Mota, 10 km S of Serra do Cipó, shrub 4 m tall on limestone (marble) outcrop in shaded valley, *W. R. Anderson, M. Stieber & J. H. Kirkbride, Jr. 36269* (UB); Mirabela, 5 km ahead of last access to Mirabela along BR-135 toward Januária, *A. Allem & V. Silva 4584, 4585, 4586, 4587, 4588* (all CEN).

KEY TO THE SOUTH AMERICAN SUBSPECIES OF *MANIHOT CARTHAGINENSIS*

1a. Fruits regularly winged . . . . . *M. carthaginensis* subsp. *hahnii*
1b. Fruits wingless.
  2a. Leaf lobes often pandurate, less often elliptic to elliptic-oblanceolate; South America (except Brazil) . . . . . *M. carthaginensis* subsp. *carthaginensis*
  2b. Leaf lobes elliptic to elliptic-oblanceolate, seldom pandurate; tropical Brazil . . . . . *M. carthaginensis* subsp. *glaziovii*

3a. Manihot dichotoma Ule, Notizbl. Bot. Gart. Berlin 5(41): 2. 1907. TYPE: Brazil. Bahia: bei Caldeirão, Oct. 1906, *Ule 7045* (syntypes, G, K photo, L, MG not seen).

Manihot catingae Ule, Bot. Jahrb. Syst. 62: 221. 1908. Syn. nov. TYPE: Brazil. Bahia: bei Remanso, Dec. 1906, *Ule 7142* (syntypes, F not seen, G, K photo, L not seen).

Drawings of a floral branch and a floral bract of *M. dichotoma* var. *dichotoma,* as well as of a fruit and a seed, appear in Pax (1910, figs. 11A, B, 15F–H). This illustrated fruit is elongate and shows slightly undulate wings, these wings only slightly prominent, characters associated with this variety. Variety *dichotoma* has been more often collected than variety *undulata* and thus seems more common. Material of variety *dichotoma* collected by this author in Bahia shows a glabrous fruit, narrowly lanceolate, attenuate at apex, and slightly winged (wings undulate), while the seed is relatively cylindrical, rather depressed ventrally, and very thin in profile. The variety *dichotoma* occurs in Bahia near its southeastern border and adjacent Minas Gerais. The Kew phototype of synonymous *M. catingae* (*Ule 7142*) suggests a plant with foliaceous floral bracts, but experience suggests they might be crumpled leaves, as these tend to cluster around the tips of apical branches. Fortunately, the syntype at G clarifies that the species has filiform floral bracts and attenuate, slightly winged fruits, characters associated with *M. dichotoma* var. *dichotoma.* This same syntype was examined by Rogers and Appan (1973: 187), and they reported "capsules subglobose, slightly elongated, surface smooth." The type locality of *M. catingae,* the Bahian municipality of Remanso, was inundated some years ago for the construction of the hydroelectric dam "Barragem de Sobradinho," on the southwestern border of Bahia with Pernambuco.

3b. Manihot dichotoma var. **undulata** Allem, var. nov. TYPE: Brazil. Bahia: Município de Manoel Vitorino, 107 km N of Vitória da Conquista along BR-116 Hwy. to Jequié, ca. 14°10′S, 40°15′W, 380 m, glabrous treelet, 5 m tall, with flowers and fruits, 11 Nov. 1984, *A. Allem & W. Werneck 2934* (holotype, CEN; isotype, DAV). Figure 3.

A *M. dichotoma* Ule fructibus conspicue alatis et seminibus majoribus differt.

Treelet 4–9 m tall, glabrous in vegetative and floral parts, highly branched. Stems with copious white latex exudate. Leaves alternate; stipules conspicuous, margins laciniate; petioles 5–15(–20) cm long, cylindric, greenish; petiole basally attached; upper lamina deep green, pale green beneath, the lamina simple, (3)5(7)-deeply cleft, chartaceous; median lobe elliptic to elliptic-oblanceolate, 3–10(–12) × 1–3(–5) cm, often pandurate, lamina edges entire or slightly undulate, apex acuminate or eventually cuspidate; outermost lobes smaller than median lobes. Monoecious inflorescence, terminal, glabrous, lax raceme, 3–8(–10) cm long; mature male floral bracts small, rather inconspicuous, very early deciduous, narrowly lanceolate, margins slightly toothed to ciliate, 3–5(–10) × 0.5–1(–1.5) mm; bracteoles half this size, ovate to lanceolate. Mature male buds somewhat conic-lanceolate, attenuate at tip. Male flower: pedicel 4–8(–10) mm, perianth 9–15 mm long, cleft in apical third into 5 lobes, tepal greenish and glabrous externally; stamens 10, in 2 whorls of 5 each; glandular disc fleshy and conspicuous. Female flower: restricted to the lowermost part of the bisexual inflorescence and at times in clusters of 2 to 5 solitary flowers in the branches of the upper dichotomies; pedicel somewhat thickened, 10–20 mm long; perianth 10–15 mm long, cleft to the base into 5 lobes, tepals broadly triangular, glabrous externally; ovary cylindric and wholly glabrous, strongly winged; wings undulate; stigma fimbriate; glandular disc conspicuous. Mature fruit larger than the average fruit of the genus, glabrous, cylindric, its top somewhat blunt, strongly winged, wings prominently undulate, dehiscent, green in fresh material, 18–20(–24) mm from base to apex, 14–16(–18) mm wide. Ma-

Figure 3. *Manihot dichotoma* var. *undulata* Allem (drawn from holotype, *Allem & Werneck 2934*). —A. Flowering branch with conspicuous undulate-winged fruits. —B. Mature male floral bracteole. —C. Mature male floral bract. —D. Young seed, ventral view. —E. Mature male bud. —F. Male flower.

ture seed rather compressed, broadly cylindric, ca. 14–20 × 8–12 mm, gray to grayish, carunculate; caruncle showy.

Distribution. Wild *Manihot dichotoma* var. *undulata* has been found only among xerophilous vegetation in Bahia; it is also locally cultivated as a living fence.

Phenology. This variety sets flowers in late October and sets fruits from January through early April.

Paratypes. BRAZIL. **Bahia:** Irecê, 9 km SW of Irecê along BA-052 Hwy. to Central, *A. Allem & W. Werneck 3735* (CEN); Manoel Vitorino, ca. 100 m ahead of the crossroads between BR-116 Hwy. and dirt road to Catingal, *A. Allem & V. Silva 4520* (CEN); Boa Nova, 28, 7 km SW of Manoel Vitorino along BR-116 Hwy. to Poções, *A. Allem & V. Silva 4525* (CEN).

The varietal name refers to the unique ornamentation of the fruit's surface.

KEY TO THE BRAZILIAN VARIETIES OF *MANIHOT DICHOTOMA*

1a. Fruit narrowly lanceolate, elongated, wings narrowly undulate or at times almost absent; seed ca. 5 mm wide . . . . . *M. dichotoma* var. *dichotoma*
1b. Fruit cylindric, broadened, wings broadly undulate and showy; seed ca. 12 mm wide . . . . . *M. dichotoma* var. *undulata*

Manihot dichotoma var. *undulata* is characterized by cylindric, glabrous, strongly undulate and conspicuously larger fruits. These wings are so wide (to 4 mm) and invaginate outward to such an extent that they may obscure much of the fruit's surface. Its seeds are similar to those of variety *dichotoma*, but they are much larger.

Acknowledgments. Grady Webster, Victoria Hollowell, and an anonymous referee painstakingly corrected the text in full. I thank Tarciso S. Filgueiras for the Latin diagnoses. I am indebted to Iuri Cozac and Flávio Teodoro Chaves for the line drawings. The curators of the herbaria G, K, and M kindly loaned critical type materials for examination. The specimen from W was examined while in England in 1982.

Literature Cited

Allem, A. C. 1979a. Notas taxonômicas e novos sinônimos em espécies de *Manihot*. IV. Euphorbiaceae. Rev. Brasil. Biol. 39: 735–738.

———. 1979b. Notas taxonômicas e novos sinônimos em espécies de *Manihot*. V. Euphorbiaceae. Rev. Brasil. Biol. 39: 891–896.

———. 1989a. A revision of *Manihot* section *Quinquelobae* (Euphorbiaceae). Rev. Brasil. Biol. 49: 1–26.

———. 1989b. Four new species of *Manihot* (Euphorbiaceae) from Brazil. Rev. Brasil. Biol. 49: 649–662.

———. 1994. *Manihot* germplasm collecting priorities. Report of the First Meeting of the International Network for Cassava Genetic Resources, CIAT, Cali, Colombia, 18–23 August 1992. International Crop Network Series No. 10, pp. 87–110. International Plant Genetic Resources Institute, Rome, Italy.

———. 1999. A new species of *Manihot* (Euphorbiaceae) from the Brazilian Amazon. Int. J. Pl. Sci. 160: 181–187.

———. 2001. The origins and taxonomy of cassava (*Manihot esculenta* Crantz subspecies *esculenta*). *In:* R. J. Hillocks, M. J. Thresh & A. C. Bellotti (editors), Cassava: Biology, Production and Utilization. CABI International, Oxford (in press).

Croizat, L. 1943. Preliminari per uno studio del genere *Manihot* nell' America meridionale. Revista Argent. Agron. 10: 213–226.

Pax, F. 1910. Euphorbiaceae–Adrianeae. Pp. 1–111 *in* A. Engler (editor), Das Pflanzenreich, IV. 147. II. 44.

Rogers, D. J. & S. G. Appan. 1973. *Manihot* and *Manihotoides* (Euphorbiaceae), a Computer-Assisted Study. Fl. Neotrop. Monogr. 13. Hafner Press, New York.

Second, G. 2000. *Manihot glaziovii* contributed to the genetic make-up of cassava and represents an example of dynamic conservation and on-farm breeding of genetic resources. Pp. 135–143 *in* L. J. C. B. Carvalho, A. M. Thro & A. D. Vilarinhos (editors), Cassava Biotechnology: IV International Scientific Meeting—CBN. Embrapa Recursos Genéticos e Biotecnologia, Brasília. CBN, 2000.

——— & C. Iglesias. 2000. The state of use of cassava genetic diversity and a proposal to enhance it. Pp. 201–221 *in* H. D. Cooper, C. Spillane & T. Hodgkin (editors), Broadening the Genetic Bases of Crop Production. CAB International 2000, Oxford.

———, A. C. Allem, R. A. Mendes, L. J. C. B. Carvalho, L. Emperaire, C. Ingram & C. Colombo. 1997. Molecular markers (AFLP)-based *Manihot* and cassava numerical taxonomy and genetic structure analysis in progress: Implications for their dynamic conservation and genetic mapping. African J. Root and Tuber Crops 2: 140–147.

Zehntner, L. 1914. Estudos sobre as maniçobas do estado da Bahia, em relação ao problema das secas. ("Facsímile"). Empresa de Pesquisa Agropecuária do Rio Grande do Norte. Natal, EMPARN, Fundação Guimarães Duque, 1982. Documentos 8. Coleção Mossoroense, 244.

Aciotis (Melastomataceae): Two New Species from the Northwestern Lowlands of South America

Alina Freire-Fierro

Herbario Nacional del Ecuador QCNE, Av. Río Coca E6-115 e Isla Fernandina, Apartado 17-21-1787, Quito, Ecuador. Present address: Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63110-0299, U.S.A. http://www.joethejuggler.com/Alina

ABSTRACT. Two new species are described in the neotropical genus *Aciotis*. *Aciotis wurdackiana* is an herbaceous species with narrow chartaceous leaves, a dense cymose inflorescence, and chartaceous ovary walls, and is distributed in the northern state of Pará in Brazil. *Aciotis olivieriana* is an herbaceous species characterized by cordate and papery leaves, a lax cymose inflorescence, and coriaceous ovary walls, and is distributed in the lowlands of northwestern South America.

RESUMEN. Se describen dos nuevas especies del género neotropical *Aciotis*. *Aciotis wurdackiana* es una especie herbácea con hojas angostas cartáceas, inflorescencia cimosa densa, paredes del ovario cartáceas, y distribuída únicamente en el estado de Pará al norte del Brasil. *Aciotis olivieriana* es una especie herbácea caracterizada por las hojas cordadas y papiráceas, inflorescencia cimosa laxa, paredes del ovario coriáceas y distribuída en las tierras bajas del noroeste de América del Sur.

Key words: *Aciotis*, Brazil, Colombia, Ecuador, Melastomataceae, Peru, South America, Venezuela.

Aciotis D. Don, a typical melastome in its opposite leaves with palmate-parallel venation and cymose inflorescences, is a neotropical genus of 13 species (Freire-Fierro, in press) characterized by an herbaceous habit, with or without spiral tracheids, small actinomorphic flowers, stamens lacking dorsal connectives, and fruits either dry or fleshy. *Aciotis* species occur primarily in humid lowlands from Mexico through Brazil in disturbed habitats such as abandoned fields and secondary forests. They also grow in wetlands and swamps, and are less often found in primary forests or in dry sandy areas. Some species of *Aciotis*, like species of *Desmoscelis* Naudin, *Brachyotum* (DC.) Hooker f., *Pterolepis* (DC.) Miquel, and *Tibouchina* Aublet have prosenchymatous shaggy trichomes with sclerenchyma fibers borne at their bases that run subepidermically on the lower surface of the leaves giving a root-like appearance (Solereder, 1908). These running sclerenchyma fibers give the lower surface the appearance of web-like striations. The spiral tracheids observed in the mesophyll of leaves of *Aciotis wurdackiana* have previously been observed in *Aciotis annua* (Martius ex DC.) Triana (Solereder, 1908), and in species of *Bellucia* Necker ex Rafinesque, *Henriettea* DC., and *Sonerila* Roxburgh (Metcalfe & Chalk, 1972).

Cogniaux (1891) and Renner (1993) have placed *Aciotis* in the tribe Melastomeae [Tibouchineae] because of the cochleate seeds and the presence of capsular fruits in several species.

In anticipation of the revision of the genus (Freire-Fierro, in press), two new species are published here. *Aciotis wurdackiana* comes from the Amazonian lowlands of Brazil, and *A. olivieriana* occurs in the lowlands of Brazil, Colombia, Ecuador, and Venezuela. Both species had been previously named by Mathies in an unpublished doctoral thesis (Mathies, 1981). Through my revision and study of more material and gathering of new data, I am able to validate some of his results.

Aciotis wurdackiana Freire-Fierro, sp. nov. TYPE: Brazil. Pará: Rio Trombetas, vicinity of Cachoeira Porteira 01°55′S, 55°50′W, 21 May 1974, *G. T. Prance, D. G. Campbell, J. C. Ongley, J. F. Ramos, O. P. Monteiro & B. W. Nelson 22220* (holotype, INPA; isotypes, AAU, F, GH, K, MO [sheet 3489413], NY, S). Figure 1.

Planta erecta, caule trichomatibus eglandulosis pilosulo, glabrescente; xylemate tracheidis spiraliformibus praedito. Folia elliptica, subtus striis retiformibus ornata. Inflorescentia ex cyma duplo bipara constans; bracteis conspicuis. Fructus capsularis. Haec species ab *A. annua* caule glabrescente, foliis ellipticis 3- ad 5-nervatis (nec 5- ad 7-nervatis) perangustioribus minoribusque atque petalis anguste ellipticis (nec obovatis) differt.

Plant approximately 0.4 m high, erect; stolons absent; stem quadrangular with inconspicuous wings, glabrescent, initially with eglandular trichomes < 1 mm long. Leaves with petiole 0.2–0.9 cm long, unwinged, eglandular-pubescent with trichomes > 1 mm long; blade 1.2–3.1 × 0.6–1.4

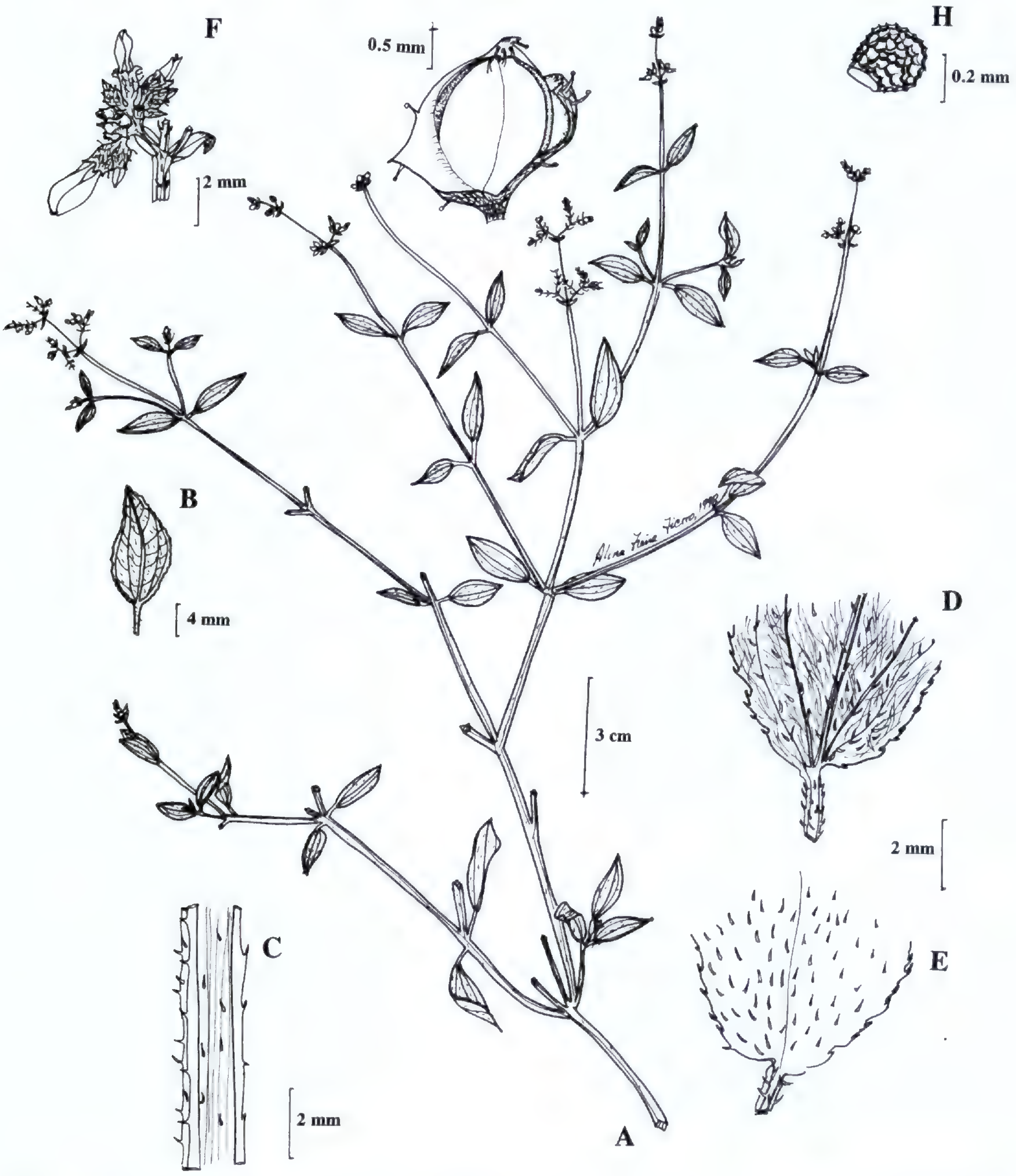


Figure 1. *Aciotis wurdackiana* Freire-Fierro. —A. Habit. —B. Leaf. —C. Stem. —D. Lower surface of leaf showing web-like striations. —E. Upper surface of leaf. —F. Inflorescence section. —G. Capsular fruit with glandular ovary apex. —H. Seed with foveolate testa. (A–F based on *Prance 22220*; G–H from *Campbell et al. P22526.*)

cm, papery, elliptic, 3- to 5-veined, the base cuneate to truncate, the apex acute, the margin serrulate; upper leaf surface dark green, pilosulous with eglandular trichomes, lower surface whitish green due to prosenchymatous sclerenchyma fibers, pubescent with eglandular trichomes with root-like sclerenchyma fibers. Inflorescence a simple cyme or a double biparous or uniparous cyme, 7.2–8 × 2.2–2.5(–4.5) cm, with 2 to 4 pairs of first order paraclades; rachis glandular-pubescent; internodes 0.8–1 cm long; first order hypopodia 0.2–0.3 cm long, biparous or uniparous; second order hypopodia 1.3–2.2 cm long, uniparous; third order hypopodia ca. 0.2 cm long, uniparous; fourth order hypopodia lacking; congested terminal paraclade 0.6–1.2 cm long with 5 to 8 flowers per cm; bracts 2.5–5.0 × 0.8–0.9 mm, narrowly elliptic, the apex acute to acuminate, dorsally glandular pubescent. Hypan-

thium 1.5–2.2 × 1–1.2 mm, with spiral tracheids in parenchyma, externally densely glandular-pubescent, internally glabrous or with few glandular trichomes; petals ca. 2.5 × 0.8–0.9 mm, narrowly elliptic, base cuneate, apex acute, without a terminal glandular trichome, dorsally glabrous; stamens with filaments 2.2–2.5 mm long, anthers 1.2–1.8 mm long, purple, pedoconnective ca. 0.1 mm long; ovary with apex glandular pubescent. Fruit capsular, 1.5–2.2 × 1–1.5 mm, bilocular, the ovary wall chartaceous; seeds ca. 0.4 × 0.2–0.3 mm.

Flowering and fruiting. *Aciotis wurdackiana* flowers and fruits from May to July.

Distribution and habitat. Despite the wide distribution of *Aciotis* species in Brazilian Amazonia, *A. wurdackiana* occurs only in a small area in the northwestern part of Pará State and occupies disturbed areas along rivers, secondary forests, and wet areas on white sands from 10 to 760 m elevation.

Variation and affinities. *Aciotis wurdackiana* is similar to *A. annua*, *A. polystachya* (Bonpland) Triana, and *A. ornata* (Miquel) Gleason because of the root-like bases of the trichomes, the spiral tracheids in the hypanthial parenchyma, and the dry fruit. The pubescence of the stems and the wider ovate leaf distinguishes *A. annua* from *A. wurdackiana*. *Aciotis polystachya* differs from *A. wurdackiana* by the stems densely covered with glandular trichomes, and by the much smaller bracts; *A. ornata* is different from *A. wurdackiana* by the stems densely covered by lanose and reddish trichomes and by much bigger leaves with an obtuse apex.

The specific epithet *wurdackiana* honors the late John J. Wurdack (1921–1998), a well-known botanist who worked tirelessly with Neotropical Melastomataceae.

Paratypes. BRAZIL. **Pará:** Rio Trombetas, Cachoeira Porteira, próxima a foz do rio Mapuera, 18 June 1980, *Martinelli 7039* (INPA, NY, US); 4 km S of Cachoeira Porteira, June 1974, *Campbell et al. P22526* (GH, INPA, K, NY, S, US); Municipio Oriximiná, Cachoeira Porteira, km 5, 18 June 1980, *Cid & Ramos 1038* (F, GH, INPA, MICH, NY, US), 18 June 1980, *Davidson & Martinelli 10364* (INPA, NY, US), 5 June [19xx], *Silva & Santos 4708* (NY, US).

Aciotis olivieriana Freire-Fierro, sp. nov. TYPE: Colombia. Meta: Villavicencio 04°09′N, 73°37′W, 500 m, 19 Mar. 1939, *A. H. G. Alston 7650* (holotype, US; isotypes, BM, COL, NY, S). Figure 2.

Planta erecta usque subprostrata, caule trichomatibus glandulosis pubescente; xylemate tracheidis spiraliformibus destituto. Folia cordiformia, subtus striis retiformibus destituta. Inflorescentia ex cyma duplo bipara constans; bracteis inconspicuis. Fructus capsularis. Haec species ab *A. polystachya* foliis subtus striis retiformibus destitutis atque xylemate tracheidis spiraliformibus destituto, ab *A. viscida* foliis minoribus membranaceis atque cymis duplo biparis differt.

Plant 14–30 cm high, erect to prostrate; stolons present or absent; stem quadrangular with inconspicuous wings, glandular pubescent with trichomes < 0.5 mm long. Leaves with petiole (0.3–)1.3–3.2 cm long, narrowly winged, glandular-pubescent with trichomes < 1 mm long; blade 1.5–3(–5) × (1–)2.3–2.8(–3.6) cm, membranous, cordiform, 7-veined, the base cordate, the apex acute to acuminate, the margin serrulate, upper leaf surface dark green, pubescent with whitish eglandular adpressed trichomes, lower surface light green, pubescent, with eglandular adpressed trichomes. Inflorescence a double biparous cyme (rarely a thyrse), 6–14 × (3–)4–5.5(–7) cm, with 2 or 3 pairs of first order paraclades; rachis glandular pubescent; internodes 1.5–3 cm long; first order hypopodia 1–1.5 cm long, biparous; second order hypopodia 0.3–0.7 cm long, biparous or uniparous; third order hypopodia 0.2–0.5 cm long, uniparous (rarely biparous); fourth order hypopodia lacking; terminal paraclade 1–2.5 cm long with 2 or 3 flowers per cm; bracts 0.8–1.5 × 0.2–0.5 mm, triangular, the apex acuminate, dorsally glabrous. Hypanthium ca. 1.5 × 1–1.8 mm, without spiral tracheids in parenchyma, externally with few glandular trichomes, internally glabrous; petals ca. 2.5 × 1 mm, obovate, base cuneate, apex obtuse, without a terminal glandular trichome, dorsally glabrous; stamens with filaments 2–2.5 mm long, anthers 1.5–2 mm long, purple, pedoconnective lacking or ca. 0.1 mm long; ovary with apex glandular-pubescent. Fruit a capsule, 2.2–2.5 × 1.5–1.8 mm, bilocular, the ovary wall coriaceous; seeds 0.3–0.4 × ca. 0.25–0.3 mm.

Flowering and fruiting. *Aciotis olivieriana* flowers and fruits from March to June and again from August to January.

Distribution and habitat. This species has been collected in western Venezuela, northwestern Brazil, and eastern Colombia, Ecuador, and Peru. It inhabits riverbanks and primary forests at 125 to 1350 m elevation.

Variation and affinities. *Aciotis olivieriana* is similar to *A. polystachya* and *A. viscida* (Bentham) Freire-Fierro by the glandular trichomes on the stems and the cordate leaves. However, *A. olivieriana* differs from *A. polystachya* in the absence of the running sclerenchyma fibers on the leaf undersurface, the lack of trichomes with root-like bases,

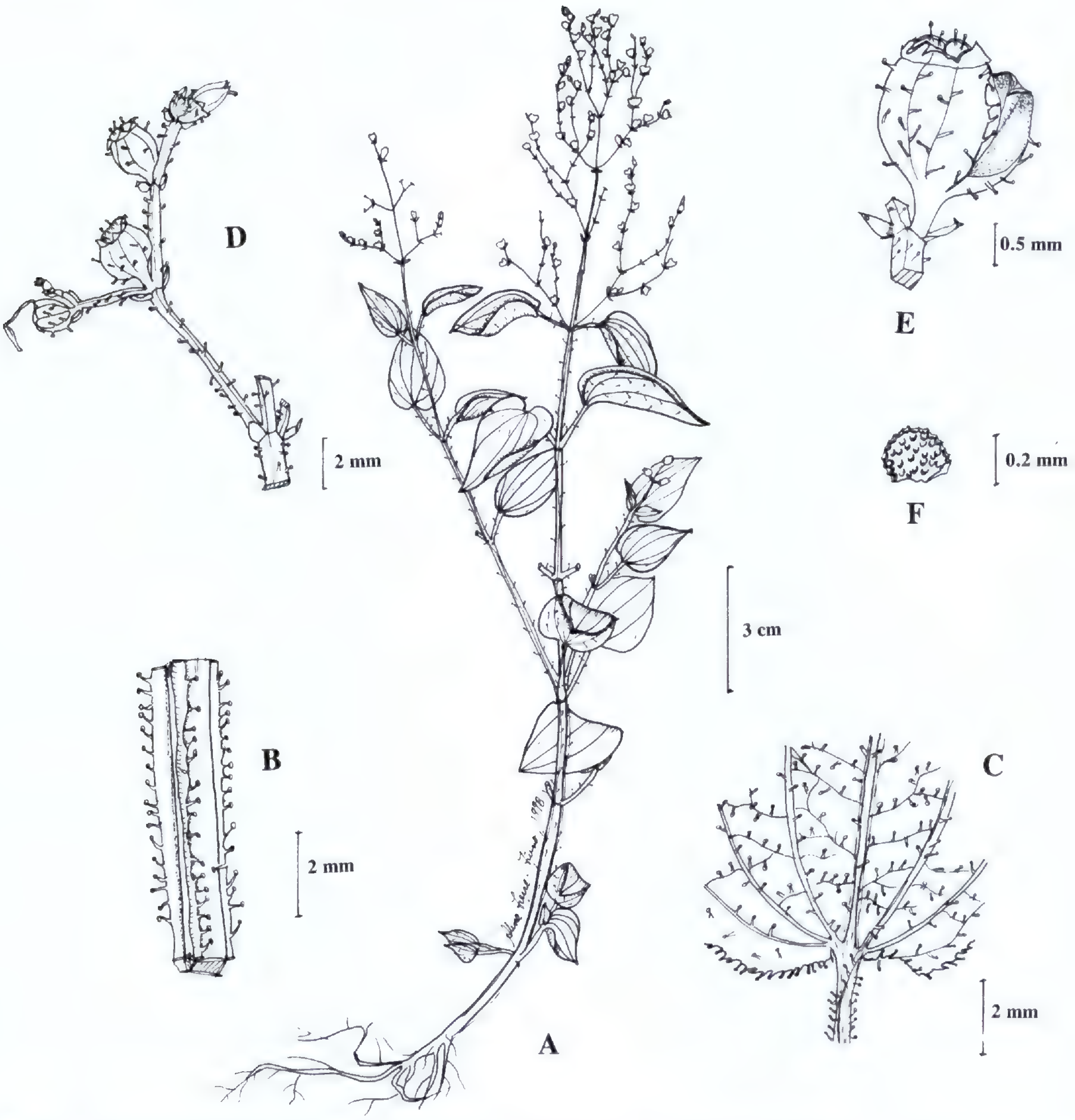


Figure 2. *Aciotis olivieriana* Freire-Fierro. —A. Habit. —B. Stem. —C. Lower surface of leaf. —D. Inflorescence. —E. Open capsular fruit. —F. Seed with foveolate testa. (From *Sastre 968.*)

and the lack of spiral tracheids; it differs from *A. viscida* in its smaller and membranous leaves, doubly cymose inflorescences, and the absence of glandular trichomes on the dorsal surfaces of petals. Similarly, *A. olivieriana* could be confused with some representatives of *A. acuminifolia* that have cordate leaves, but it differs from the latter in having 7-veined leaves, glandular trichomes on the stems and petioles, and elongated anthers lacking pedoconnectives. Because of these morphological similarities, *Aciotis olivieriana* has usually been misidentified as *A. polystachya* or *A. acuminifolia*, delaying, therefore, the recognition of this new species.

Like *Aciotis wurdackiana, A. olivieriana* has also been collected in the state of Pará (Brazil), but it differs from the former in the cordate leaves, elongated and lax inflorescence, and absence of trichomes with root-like bases.

Vernacular name. *Daicap* (Amazonas, Peru).

Mathies (1981, unpublished Ph.D. thesis) originally described this species using the epithet "olivierii," honoring his wife Shirley Olivieri Mathies.

Paratypes. BRAZIL. **Amazonas:** São Gabriel da Cachoeira, Rio Negro, 1852, *Spruce 2123* (BM, K, M, NY, US), 5 Sep. 1981, *Renner 363* (INPA); upper Rio Negro, Manaus–Caracarai, km 45, 28 May 1984, *Renner 955* (AAU); Reserva Forestal Ducke, Manaus–Itacoara, km 26,

Floresta de Vertente, 25 Apr. 1995, *Sothers 417* (INPA); km 26, Estação de Meteorologia, June 1997, *Sothers 1011* (INPA); Manaus, estação da Silvicultura, INPA km 45, 26 May 1984, *Miranda et al. 218* (INPA); Waupes, Rio Negro, 21 Dec. 1964, *Vogel et al. 341* (INPA, US). **Pará:** Rio Trombetas, Porteira, 8 June 1974, *Campbell et al. P22492* (K, MG, NY, S, US). COLOMBIA. **Meta:** Villavicencio, 1 Jan. 1856, *Triana 6195a* (BM); río Guatiquía, 20 Nov. 1948, *Araque & Barkley 18M34* (COL, US); Sierra La Macarena, Bocas del río Duda, 30 Oct. 1975, *Idrobo 8365* (COL); El Mico Airstrip (Camp 1), 13 Nov. 1949, *Philipson et al. 1401* (BM, COL, NY [2 sheets], US); opposite Hda. San Carlos, 29 Jan. 1944, *Hermann 11133* (COL, NY, US), 12 Oct. 1938, *Cuatrecasas 1995* (NY, US), 12 Oct. 1938, *Cuatrecasas 3505* (F); toward El Parrao, 10 Nov. 1938, *Cuatrecasas 4584* (F, US); Sabanas de San Juan de Arama, Dec. 1950, *Idrobo & Schultes 579* (COL [2 sheets]); Río Sardinata, Mar. 1971, *Sastre 968* (COL). **Putumayo:** 2 Dec. 1980, *Croat 51747* (COL, MO). **Vaupés:** San Felipe, 21 Nov. 1948, *Romero-Castañeda 1213* (COL, NY). ECUADOR. **Napo:** between Tena and Napo, 6 Oct. 1939, *Asplund 9349* (S); about 11 km ESE of Puerto Misahuallí, ca. 3 km E of Jatun Sacha, 2 June 1988, *Renner 69334* (AAU); Tena, Hacienda Dos Ríos, Río Misahuallí; Archidona, 12 May 1933, *Heinrichs 416* (G [2 sheets], M, NY, Z [2 sheets]). **Zamora Chinchipe:** Macas, 19 Mar. 1956, *Asplund 19836* (S). PERU. **Amazonas:** Labanda, Huampami, Rio Cenepa, 3 Aug. 1974, *Ancuash 696* (GH, XAL). **San Martín:** Tarapotó, 1856, *Spruce s.n.* (K). VENEZUELA. **Amazonas:** San Carlos de Río Negro, Apr. 1970, *Steyermark & Bunting 102703* (US); Alto Río Orinoco, Isla Quiratare and Esmeraldas, 22 Mar. 1953, *Maguire & Wurdack 34625* (K, NY, US); Mavaca, Alto Orinoco, Indios Guaicas (Yanomanö), Jan. 1970, *Aristeguieta & Lizot 7384* (NY, US), 1984, *Stergios & Aymard 7265* (MO, US). **Bolívar:** Salto Pará, Aug. 1991, *Meier 240* (US). **Distrito Federal:** Caracas, s.d. *Landsberge van 19* (S).

Acknowledgments. I thank FUNDACYT (Fundación para la Ciencia y la Tecnología del Ecuador)-LASPAU, the University of Missouri-St. Louis, the Missouri Botanical Garden, the California Academy of Sciences, the Pontificia Universidad Católica del Ecuador, and the Herbario Nacional del Ecuador for their help. I thank also the curators of A, AAU, AMES, BHCB, BM, BR, C, CAS, CAY, COL, CR, DS, E, F, G, GB, GH, GUA, HB, HRB, HUA, IJ, INPA, K, LL, LPB, M, MA, MBM, MEXU, MG, MICH, MO, NY, QCA, QCNE, R, RB, S, SPF, TEX, TRIN, UC, UEC, US, VEN, W, WIS, XAL, and Z for their help with material of *Aciotis*. I thank also Roy Gereau (MO) and Javier Fernández-Casas (MA) for their help with the Latin diagnoses, and Charlotte Taylor (MO) for her suggestions on the manuscript. P. Mick Richardson helped me extensively during my stay at the Missouri Botanical Garden. My beloved husband Joseph C. Welling, together with my families, the Wellings and the Freire-Fierros, have been of great support for me.

Literature Cited

Cogniaux, C. A. 1891. Melastomaceae. Pp. 1–1256 *in* A. & C. de Candolle (editors), Monogr. Phan. 7.

Freire-Fierro, A. In press. Revision of *Aciotis* (Melastomataceae). Syst. Bot. Monogr.

Mathies, P. S. 1981. A Revision of *Aciotis* (Melastomataceae). Ph.D. Dissertation, Mississippi State University, Starkville, Mississippi. [Unpublished.]

Metcalfe, C. R. & L. Chalk, with the assistance of M. M. Chattaway [and others]. 1972. Anatomy of the Dicotyledons: Leaves, Stem, and Wood in Relation to Taxonomy, with Notes on Economic Uses. Clarendon Press, Oxford.

Renner, S. S. 1993. Phylogeny and classification of the Melastomataceae and Memecylaceae. Nordic J. Bot. 13: 519–540.

Solereder, H. 1908. Systematic Anatomy of the Dicotyledons: A Handbook for Laboratories of Pure and Applied Botany. Translated by L. A. Boodle & F. E. Fritsch; revised by D. H. Scott. Clarendon Press, Oxford.

Taxonomic Changes in American Metastelminae (Apocynaceae–Asclepiadoideae)

Sigrid Liede and Ulrich Meve

Department of Plant Systematics, University of Bayreuth, Universitätsstr. 30, D-95440 Bayreuth, Germany

ABSTRACT. One new species of *Cynanchum* from Ecuador is described, *C. schizocoronum* Liede & Meve, distinguished by its entirely fused corona with pronounced interstaminal folds and a strongly lacerate upper margin. One South American *Cynanchum* species is transferred to *Oxypetalum*, one to *Blepharodon*, two to *Jobinia*, two to *Metastelma*, two to *Petalostelma*, and one to *Tassadia*. One new synonym is recognized in *Ditassa* and one in *Tassadia*. The sectional affiliation of six species of *Cynanchum* is clarified.

Key words: Apocynaceae, Asclepiadoideae, *Blepharodon*, *Cynanchum*, *Ditassa*, Ecuador, *Jobinia*, *Metastelma*, Metastelminae, *Oxypetalum*, *Petalostelma*, South America, *Tassadia*.

In the Old World, the concept of *Cynanchum* L. (Asclepiadeae–Metastelminae) is rather clear-cut after the exclusion of *Vincetoxicum* Wolf (Liede, 1996a). In the New World, Woodson (1941), based on North American material, united morphologically highly diverse material with *Cynanchum*. Liede and Meve (1997) excluded some obvious misfits from the genus, and Liede (1997a) attempted to structure the speciose conglomerate on the sectional level. The two morphologically most distinct sections, *Mellichampia* (A. Gray ex S. Watson) Sundell and *Roulinia* (Decaisne) Sundell, had been revised earlier by Sundell (1981). In the course of a thorough revision of the American Metastelminae and treatments for various South and Central American flora projects, one new species was encountered and several species were found that better fit the concept of some smaller genera than of even a widely circumscribed *Cynanchum*. Instead of a single morphological character (an at least basally ring-shaped gynostegial corona), a wider range of vegetative and reproductive characters is used to assess generic affinity, an approach that has been confirmed in Old World Asclepiadeae by recent molecular research (Liede, unpublished data).

Terminology follows Liede and Weberling (1995) for inflorescences, with "sciadioidal" denoting an umbel-shaped inflorescence derived from a bostryx by shortening of internodes. For details of corona structure, Liede and Kunze (1993) is followed, with Cs denoting staminal parts, Ci denoting interstaminal parts of a gynostegial corona, and C(is) indicating the fused portion of staminal and interstaminal parts. Details of anther structure and function are explained in Liede (1996b). Indumentum terminology is applied according to Hewson (1988).

NEW SPECIES

Cynanchum schizocoronum Liede & Meve, sp. nov. TYPE: Ecuador. Chimborazo: thickets, 1200–1500 m, 20 Feb. 1955, *Asplund 15474* (holotype, S). Figure 1.

Species bene distincta margine supere coronae lacerato et bifide.

Plants small climbers, twining, sparsely irregularly branched. Shoots perennial, herbaceous, sparsely covered along two lines with recurved trichomes, 300–400 μm long. Internodes 40–70 cm long, ca. 1 mm diam. Latex white. "*Stipules*" absent. *Leaves* with petiole 10–20 mm long, blades herbaceous, with 2–4 colleters at the base, discolorous, 30–60 × 15–25 mm, ovate, basally cordate, apically acute, marginally straight and not thickened, adaxially isolatedly and evenly covered with appressed trichomes, 150–200 μm long, abaxially glabrous. *Inflorescences* always one per node, extraaxillary, 4- to 6-flowered, all flowers open synchronously, sciadioidal. Peduncles 3–6 mm long, densely covered along a single line with recurved trichomes, 150–200 μm long. *Floral bracts* 0.8–1 × ca. 0.5 mm, ovate, with trichomes. Pedicels 4–7 mm long, densely covered along a single line with recurved trichomes, 150–200 μm long. *Mature floral buds* ca. 4 mm long, ca. 3.5 mm diam., ovoid to globose, with imbricate aestivation. *Calyx* basally fused, ciliate; lobes 1.3–1.5 × ca. 1 mm, ovate, apically acute. *Corolla* rotate, 4–6 mm long, cream to greenish yellow, glabrous; lobes basally fused, 2.2–2.5 mm wide, ovate, apically acute to acuminate, marginally smooth. *Gynostegial corona* of connate staminal and interstaminal parts (C(is)), white,

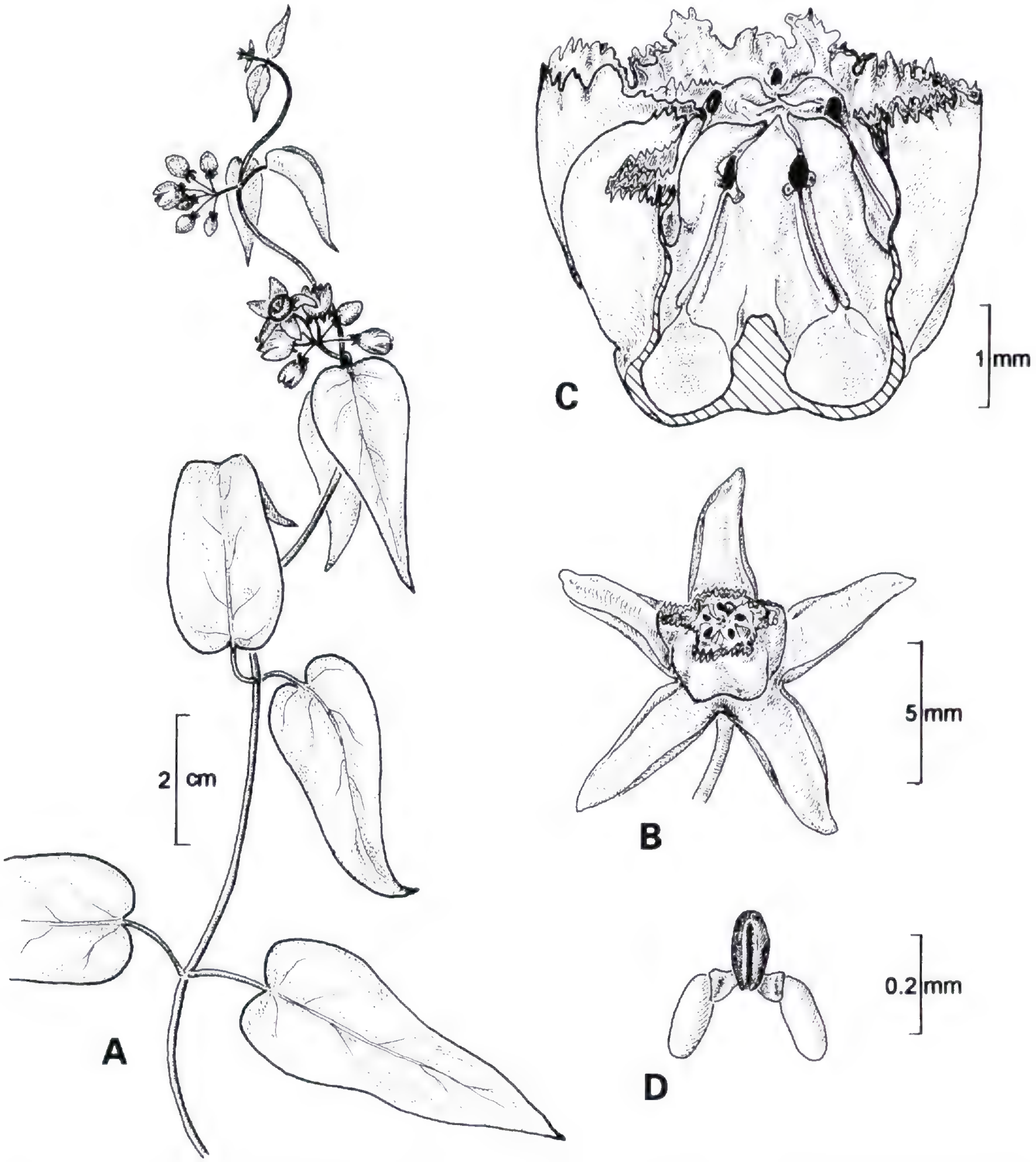


Figure 1. *Cynanchum schizocoronum* Liede & Meve. —A. Habit. —B. Flower. —C. Corona in lateral view with parts of the corona removed to show the gynostegium. —D. Pollinarium. (Drawn by U. Meve from the type, *Asplund 15474*.)

1.8–2.5 mm high, equaling the gynostegium in height, cyathiform; staminal parts (Cs) basally connate to the filament, appressed to the back of the stamens, laminar, apically erect, with straight, lacerate margins, split along the upper edges; interstaminal parts (Ci) laminar, producing a pronounced convex fold along the upper two thirds of corona length, sulcate, erect, with lacerate margins split along the upper edges. *Gynostegium* 2–2.5 × 1.8–2 mm, sessile. *Stamens* with filament ca. 0.5 mm high; anthers broader than high, hexagonal, abaxially planar; anther wings 1.25 mm long, extending along the whole length of the anther, consisting of distal and proximal ridge, proximal ridge curved; anther wings of adjacent anthers parallel to each other, centrifugal, basally forming a distinct "mouth" with the basal lateral margin of the anther. *Connective appendages* 0.6 × 0.4 mm, obcordate, narrower than the stamen, slightly to strongly inflexed. *Pollinarium*: Corpusculum 300–350 μm long, ovoid, margins of the corpuscular cleft parallel, basally widened. Caudicles 100–120 μm

long, (sub-)basally inserted at the corpusculum, flattened, straight, declinate, trapezioid to rectangular. Pollinia subapically attached to the caudicles, 0.35–0.4 × 0.12 mm, ovate in cross section, oblongoid. *Stylar head* white, 0.9–1 × 0.5–0.6 mm; part above the corpusculi 0.1 mm high, shorter than the lower part, flat. Fruit, seed, and chromosome number unknown.

Flowering time. February, May, July.

No other *Cynanchum* species is known in which the corona is split vertically in two parts along the upper edge. In the New World, the only species with a similar corona and gynostegium structure is *C. morrenioides* Goyder, but there the corona entirely conceals the gynostegium. In the Old World, a Madagascan group of species around *C. andringitrense* Choux displays a very similar corona structure with an entirely fused gynostegial corona, but pronounced folds of the interstaminal corona parts. Outside Madagascar, such a corona structure has not yet been found in the Old World.

Paratypes. ECUADOR. **Chimborazo:** Huigra, 1200 m, 19 July 1939, *Asplund 7731* (S); cañon of the Río Chanchan, 1130–1500 m, 7 May 1945, *Camp E-3035* (S).

New Combinations

ASCLEPIADEAE–OXYPETALINAE

The Oxypetalinae are an exclusively South American subtribe of 12 genera, characterized by a pronounced corolla tube and a conspicuously long stylar head (Liede, 1997b).

Oxypetalum rusbyi (Malme) Liede & Meve, comb. nov. Basionym: *Cynanchum rusbyi* Malme, Ark. Bot. 25(7): 9. 1932, new name for *Vincetoxicum umbellatum* Rusby, Mem. Torrey Bot. Club 6: 78. 1879. TYPE: Bolivia. Larecaja: Viciniis Sorata, Cochipata, Echurani, 2750–3000 m, Feb. 1860, *Mandon 356* (holotype,?; isotype, S). Figure 2.

As the name *Oxypetalum umbellatum* Gardner (Hooker, Lond. J. 1: 179. 1842) is not available, the new combination has to be based on the nom. nov. of Malme (1932). Malme (1932) pointed out the similarity of this taxon with *O. streptanthum* (Malme) Liede, but placed both taxa in *Cynanchum* because they lack translator appendages. *Oxypetalum rusbyi* shares with *O. streptanthum* a twisted corolla and long stylar head (Fig. 2), and should therefore be regarded as a member of *Oxypetalum* subg. *Cryptodus* (E. Fournier) T. Meyer, in which translator appendages are absent. Both species possess a gynostegial corona of fused staminal and interstaminal lobes; however, they differ in the staminal lobes exceeding the interstaminal lobes in *O. streptanthum,* whereas both reach the same length in *O. rusbyi.*

Additional material seen. PERU. **Cajamarca:** Contumazá, Entrada de bosque Cachil, 2500 m, 13 Dec. 1993, *Sagástegui, Tellez & Tirado 15124* (F).

ASCLEPIADEAE–METASTELMINAE

Blepharodon harlingii (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum harlingii* Morillo, Ernstia 2: 62. 1992. TYPE: Ecuador. Zamora-Chinchipe: above Vallodolid, on road to Yangana, 2300 m, Feb. 1985, *Harling & Andersson 21422* (holotype, GB).

The corona of *B. harlingii* consists of five completely separate staminal parts, so that the species does not even formally fit the circumscription of *Cynanchum.* The pronounced leaf venation, the long pedunculate inflorescence, and the three-dimensional shape of the corona lobes clearly identify this species as a member of *Blepharodon,* even though the long filament tube and short guide rails are not typical of this genus.

Illustration: Morillo (1992: 70, fig. 1).

Jobinia glossostelma (Lillo) Liede & Meve, comb. nov. Basionym: *Cynanchum glossostelma* Lillo, Physis 4: 423. 1919. TYPE: Argentina. Tucumán: Bajo de Anfama, 12 Dec. 1888, *Lillo 1177* (holotype, LIL 30510; isotype, MO).

This species has also been included in *Cynanchum* only on account of its basally fused gynostegial corona. Its extra-axillary, but branched and very rich-flowered inflorescences, however, are indicative of a different affinity. The stipitate gynostegium and the extra-axillary inflorescences do not fit the present concept of *Orthosia.* A transfer to *Jobinia,* a diverse genus comprising species with both axillary and extra-axillary inflorescences, with basally and very highly fused gynostegial coronas, and with glabrous and densely pilose corolla lobes (Fontella Pereira & Schwarz, 1982; Schwarz & Fontella Pereira, 1985), seems the best solution at present.

Illustration: Meyer (1944: t. 65).

Additional material seen. ARGENTINA. **Catamarca:** El Rodeo, Jan. 1910, *Castillon 1702* (SI). **Tucumán:** Chicligasta, Estancia Las Pavas, 2300 m, 12 Dec. 1926, *Venturi 4602* (MO, S).

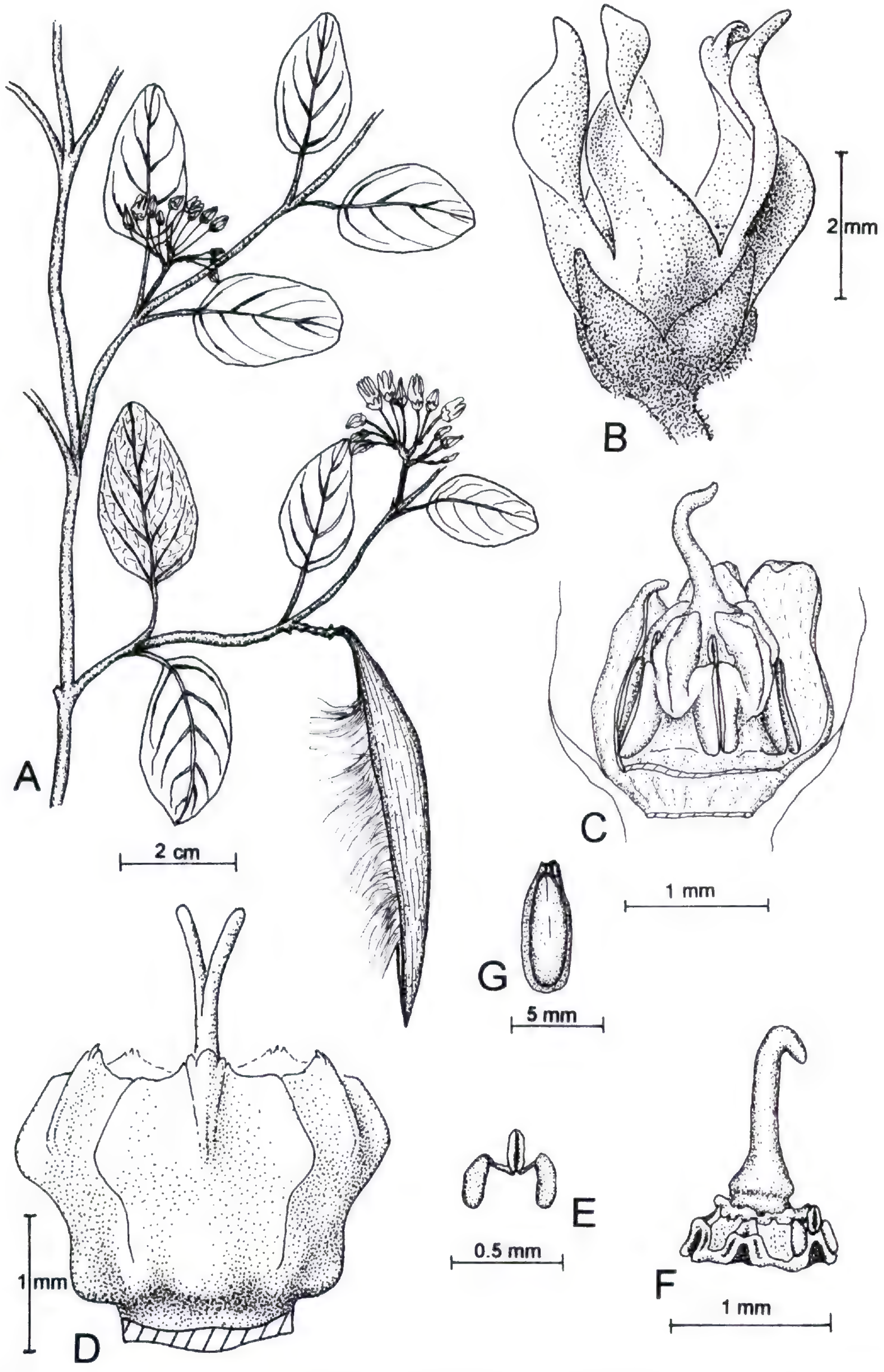


Figure 2. *Oxypetalum rusbyi* (Malme) Liede & Meve. —A. Habit, with one ripe fruit. —B. Flower. —C. Gynostegium, corona partially removed. —D. Corona. —E. Pollinarium. —F. Stylar head. —G. Seed. (A, C, E–G drawn by U. Frentsch; B, D drawn by J. Conrad from *Mandon 356*.)

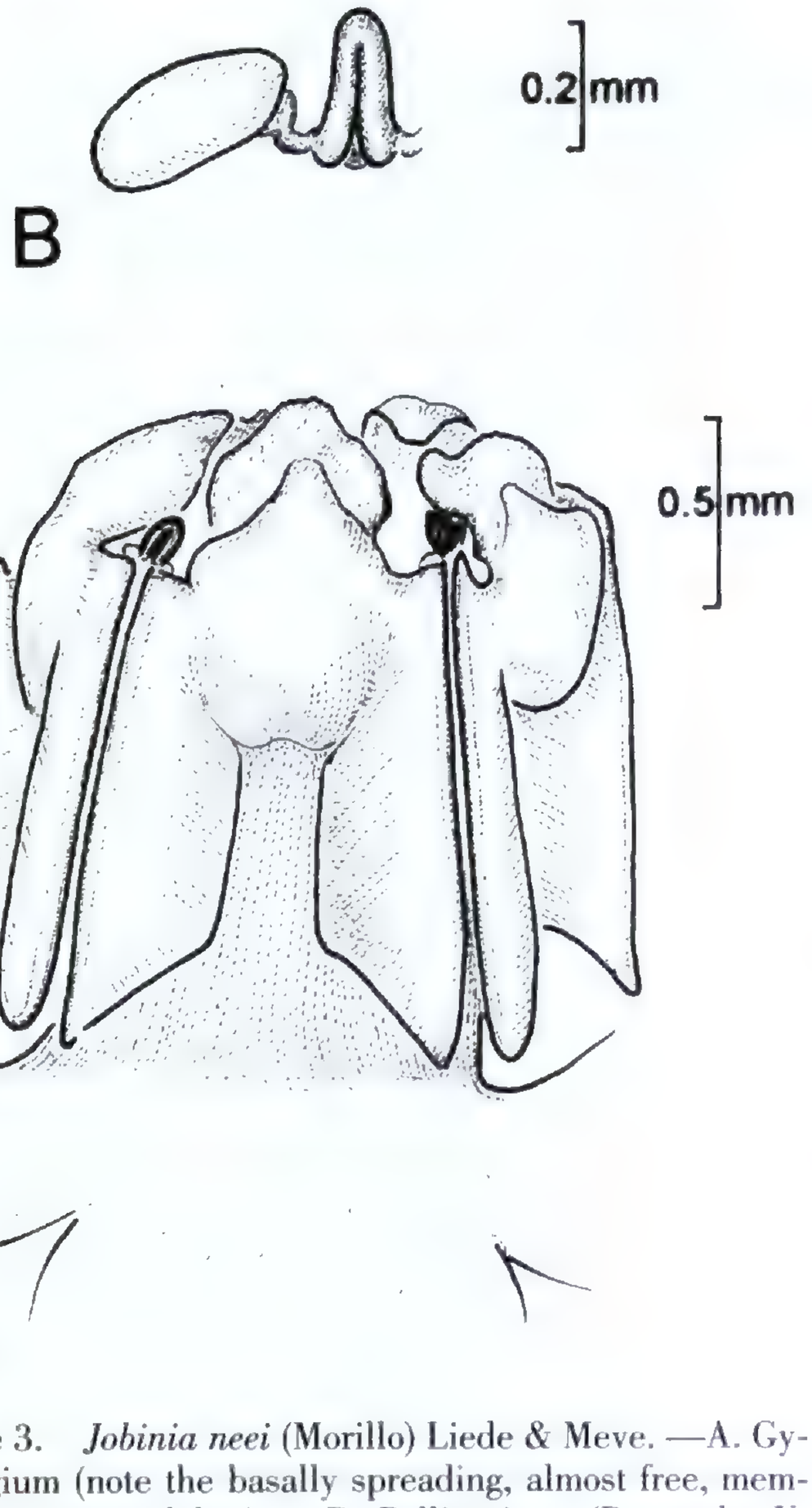


Figure 3. *Jobinia neei* (Morillo) Liede & Meve. —A. Gynostegium (note the basally spreading, almost free, membranous corona lobes). —B. Pollinarium. (Drawn by U. Meve from the type, *Nee 30728.*)

Jobinia neei (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum neei* Morillo, Ernstia 51: 5. 1989. TYPE: Venezuela. Territorio Federal Amazonas: Cerro de la Neblina, Camp VII, 1725 m, Feb. 1985, *Nee 30728* (holotype, VEN; isotypes, NY, WIS). Figure 3.

This species, with its double, axillary, branched lax inflorescences, glabrous corolla lobes, and a spreading, basally fused corona (Fig. 3), is difficult to place. Axillary inflorescences are not found in *Cynanchum,* and a comparable corona is not known for any species. In the genera with axillary inflorescences, inflorescences are too lax and flowers and pollinaria too large (Fig. 3) for *Orthosia.* Neither corona structure nor the bowl-shaped, rather large flowers agree with the present concept of *Gonioanthela.* The closely related genus *Cyathostelma,* though never formally abolished, has ceased to exist with the transfer of *C. latipes* to *Orthosia* (Malme, 1928) and *C. furcatum* E. Fournier to *Jobinia* (Fontella Pereira, 1970). *Jobinia,* again, seems the best place for this aberrant species.

Illustration: Morillo (1989, fig. 12 (habit and flower)).

Metastelma dorrii (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum dorrii* Morillo, Ernstia 2(1–2): 6. 1992. TYPE: Venezuela. Trujillo: Boconó, Páramo de Guaramacal, 2200 m, 28 Apr. 1988, *Dorr, Barnett & Coello 4971* (holotype, VEN; isotype, MERF). Figure 4.

Neither the axillary inflorescences, nor the hairy corolla lobes, nor the corona consisting solely of free staminal lobes (Fig. 4) support this species as a member of *Cynanchum.* Liede (1997a) considered it a possible candidate for transfer to *Orthosia* because of its axillary inflorescences, but the hairy corolla lobes and the free corona indicate its affinities to *Metastelma.*

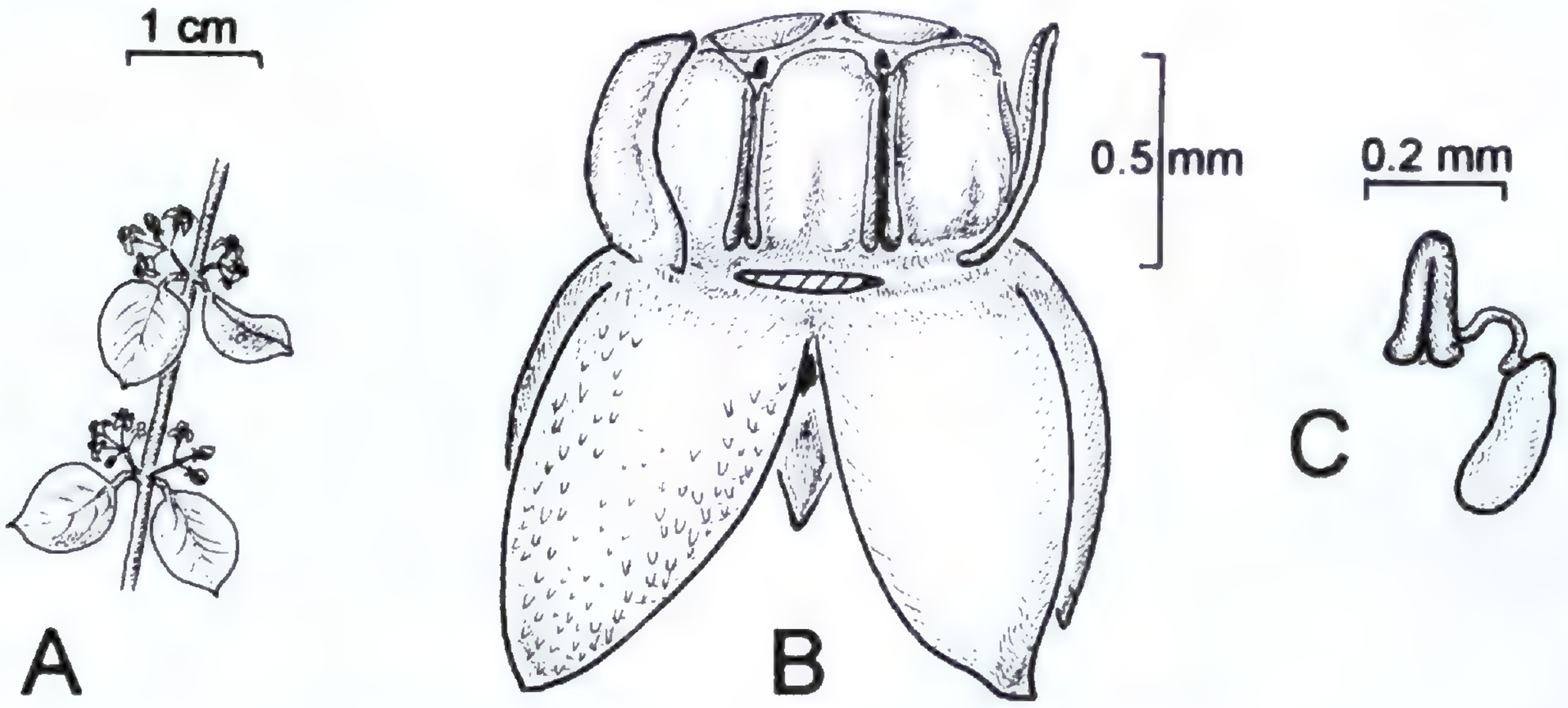


Figure 4. *Metastelma dorrii* (Morillo) Liede & Meve. —A. Habit. —B. Flower, one corona lobe removed. —C. Pollinarium. (Drawn by U. Meve from *Dorr et al. 4971.*)

Metastelma guanchezii (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum guanchezii* Morillo, Ernstia 36: 5. 1986. TYPE: Venezuela. Amazonas: Río Negro, 15–20 km S de Tama-Tama, 90 m, *Guanchez 2010* (holotype, TFA not seen; isotype, VEN).

The densely pilose corolla lobes and the corona of five distinct staminal lobes correspond to the generic characters of *Metastelma*, but not of *Cynanchum*.

Illustration: Morillo (1997: Fl. Ven. Guyana, Vol. 3).

Additional material seen. VENEZUELA. **Amazonas:** Cucurital de Yagua, ca. 120 m, 8 May 1979, *Davidse, Huber & Tillett 17356* (MO); Canaripo, 98 m, May 1978, *Huber 1926* (VEN), 125 m, Dec. 1976, *Steyermark & Redmond 112839* (VEN); Sabana Manacal, Río Atabapo, 15 km above Guarinumo, 125 m, 12 June 1959, *Wurdack & Adderley 42975* (VEN).

Petalostelma robertii (S. Moore) Liede & Meve, comb. nov. Basionym: *Vincetoxicum robertii* S. Moore, J. Bot. 42: 104. 1904. *Metastelma robertii* (S. Moore) Malme, Ark. Bot. 21A(12): 7. 1927. *Cynanchum robertii* (S. Moore) Malme, Ark. Bot., 26A(4): 28. 1934. TYPE: Brazil. Mato Grosso: Corumbá, 18 Dec. 1902, *Robert 718* (holotype, BM). Figure 5.

Petalostelma robertii is unique in South American Metastelminae for the whorled appearance of the leaves, due to the very short side branches in every leaf axil (Fig. 5). The long slender single fruits and extremely slender pedicels exclude it from *Cynanchum*, the dense indumentum on the corolla lobes from *Orthosia*. All these characters fit well with *Petalostelma*.

Additional material seen. BRAZIL. **Mato Grosso:** *Hoehne 3114* (S); Corumbá, 17 Dec. 1902, *Malme 2708* (UPS), 2 Apr. 1903, *Malme 3022* (S). PARAGUAY. Alto Chaco, 1906, *Fiebrig 1480* (S).

Petalostelma sarcostemma (Lillo) Liede & Meve, comb. nov. Basionym: *Cynanchum sarcostemma* Lillo, Physis 4: 424. 1919. TYPE: Argentina. Salta: Rosario de la Frontera, 6 Jan. 1905, *Lillo 3844* (lectotype, designated by Meyer (1944), LIL). Figure 6.

Venturi 1677 has been named as a type by Malme (1934), who did not, however, state explicitly that he chose this specimen as lectotype. Furthermore, the original description by Lillo stated Salta as the area in which the species was found, so that Meyer's (1944) lectotypification better represents the intention of the author.

Petalostelma sarcostemma is clearly misplaced in *Cynanchum*, however widely circumscribed. Its long, slender single fruits and extremely slender smooth seeds with pronounced wings are strikingly similar to those of the type of the genus, *P. martianum* E. Fournier (compare Fournier, 1885: pl. 98); further common characters include the tiny pollinaria with a lateral submedian attachment of the pollinia to the caudicles, and a very shortly pedunculate sciadioidal few-flowered inflorescence with delicate flowers (Fig. 6) that are also characteristic of the previous species, *P. robertii* (Fig. 5).

Compared to the species added to *Petalostelma* by Fontella Pereira (1994), *P. sarcostemma* shares with *P. cearense* in addition to the above characters the rather long, regularly distributed trichomes on the corolla and the entirely free corona lobes. With *P. calcarata*, it shares the massive corona lobes.

Illustration: Meyer (1944: t. 71).

Additional material seen. ARGENTINA. **Salta:** Capital, Cerro de San Bernardo, ca. 1 km from beginning of rd., 1250 m, 22 Feb. 1993, *Liede & Conrad 3101* (MO, ULM); La Candelaria; La Candelaria, right before river crossing, ca. 1000 m, 18 Feb. 1993, *Liede & Conrad 3099* (ULM). **Tucumán:** San Pedro de Colalao, 1120 m, 17 Feb. 1993, *Liede & Conrad 3090* (ULM); Trancas, Vipos, 900 m, 30 Jan. 1922, *Venturi 1677* (SI).

Tassadia manarae (Morillo) Liede & Meve, comb. nov. Basionym: *Cynanchum manarae* Morillo, Brittonia 30: 47. 1978. TYPE: Venezuela. D.F. Parque Nacional El Avila, Quebrada Quintero, 1600 m, 25 Sep. 1976, *Manara s.n.* (holotype, VEN). Figure 7.

Corona morphology in *Tassadia* and *Cynanchum* is rather similar in at least basally fused staminal and interstaminal parts and does not allow for a clear distinction between these genera. *Tassadia* is separated from *Cynanchum* by its lax inflorescence structure (Liede & Weberling, 1995) and its slender double follicles. From both characters, *T. manarae* is clearly a member of *Tassadia*, and not of *Cynanchum*. It is unusual for *Tassadia* only by its pronounced stipe (Fig. 7); however, such stipes have been encountered in almost all genera of South American Metastelminae.

Additional material seen. VENEZUELA. **Distrito Federal:** Cerro El Avila, 1900–1950 m, 17 July 1992, *W. Meier 2446* (UBT, VEN); 1970 m, 15 Aug. 1992, *W. Meier 2626* (MERF). **Miranda:** Canal de Garate, 1920–1940 m, 19 Mar. 1993, *W. Meier 3482* (MERF).

New Synonyms

Ditassa angustifolia Decaisne, in De Candolle, Prodr. 8: 575. 1844. *Cynanchum angustifol-*

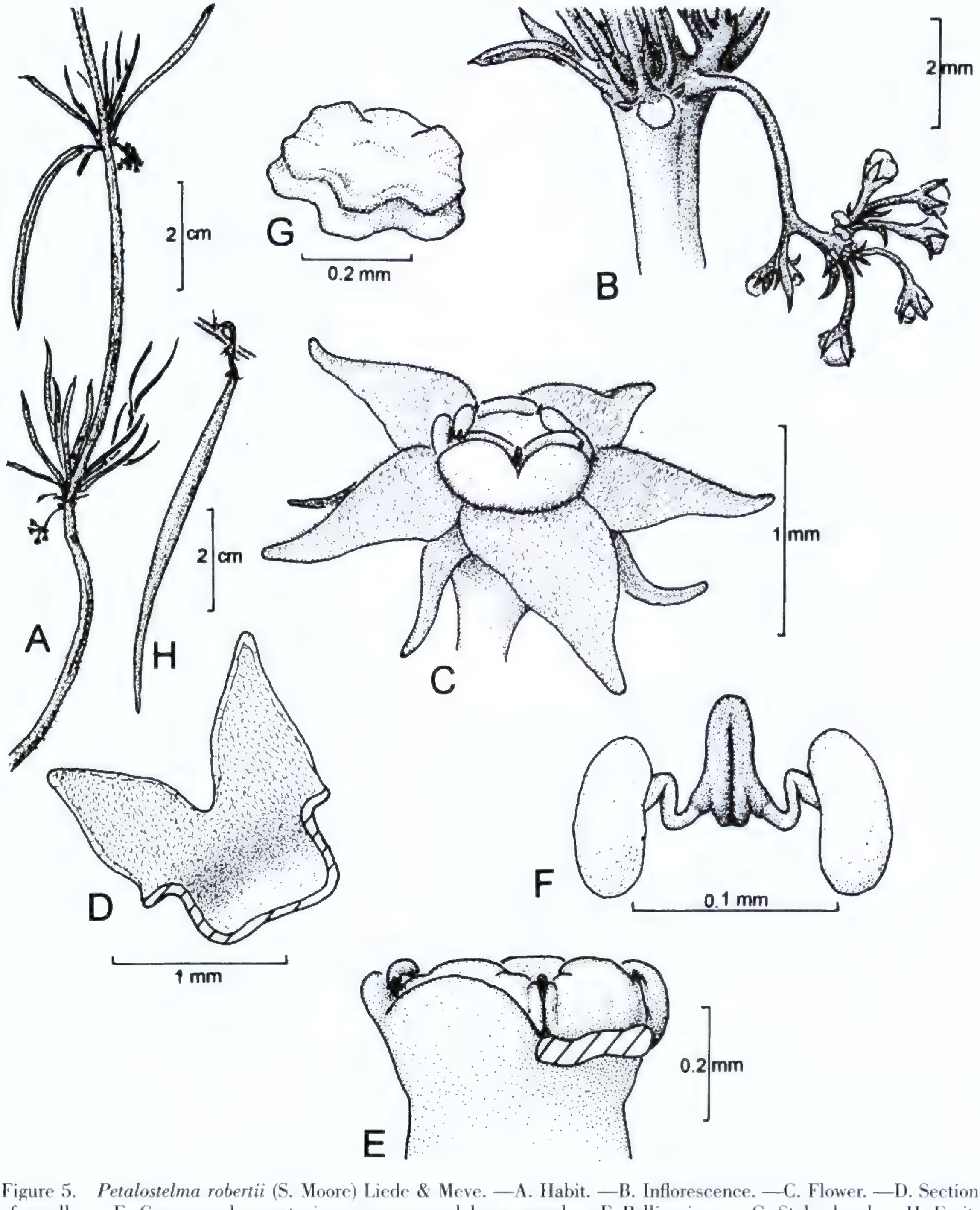


Figure 5. *Petalostelma robertii* (S. Moore) Liede & Meve. —A. Habit. —B. Inflorescence. —C. Flower. —D. Section of corolla. —E. Corona and gynostegium, one corona lobe removed. —F. Pollinarium. —G. Stylar head. —H. Fruit. (Drawn by J. Conrad from *Robert 718* except for H, which is from *Fiebrig 1480.*)

ium (Decaisne) Morillo, Ernstia 36: 3. 1986. TYPE: Guyana. Roraima: *Schomburgk 627* (holotype, P; isotype, BM). Figure 8.

Ditassa bolivarensis (R. W. Holm) Morillo, Novon 2: 32. 1992. Syn. nov. Basionym: *Cynanchum bolivarense* R. W. Holm, Fieldiana 28: 504. 1953. TYPE: Venezuela. Bolívar: Gran Sabana, at tributary to Río Kukenán, at base of Mt. Roraima, 1185–1280 m, 24 Sep. 1944, *Steyermark 58555* (holotype, F; isotype, NY).

Probably the synonymy of these two species had not been recognized earlier because of the poor state of Schomburgk's material. The leaves in particular seem much more narrow in *D. angustifolia* than in *D. bolivarensis*; however, this is clearly an

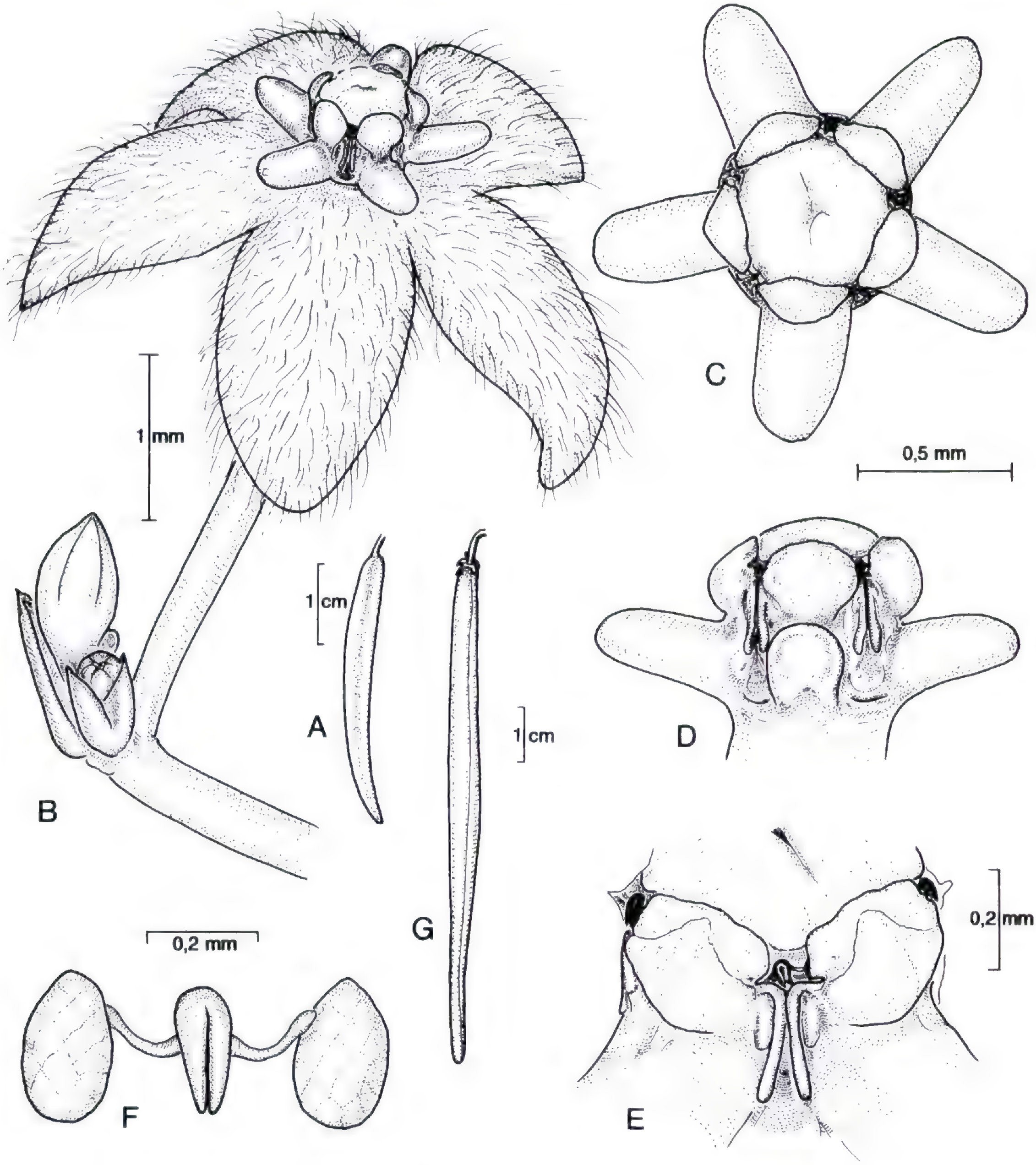


Figure 6. *Petalostelma sarcostemma* (Lillo) Liede & Meve. —A. Leaf. —B. Inflorescence with one flower open. —C. Corona and gynostegium in top view. —D. Corona and gynostegium in side view. —E. Anthers with guide rails. —F. Pollinarium. —G. Fruit. (Drawn by U. Meve from *Liede & Conrad 3090.*)

artifact of a poor drying technique. The flowers agree in all relevant characters such as size, indumentum of the adaxial side of the corolla, shape of inner and outer corona lobes, guide rails, and the peculiar mushroom-shaped stylar head (Fig. 8). In addition, the two type specimens originate from the same mountain range (Roraima), albeit from different sides, so that there is no doubt about their conspecificity.

Additional material seen. VENEZUELA. **Bolívar:** Gran Sabana, between Kun and Uaduara-parú, in valley of Río Kukenán, S of Mt. Roraima, 1065–1220 m, 1 Oct. 1944, *Steyermark 59106* (paratype, NY).

Tassadia kamaensis (Morillo) Morillo, Ernstia 51: 13. 1989. Basionym: *Cynanchum kamaense* Morillo, Ernstia 4: 8. 1981. TYPE: Venezuela. Bolívar: km 198 de la carretera El Dorado–Sta. Elena, base de Kamá-merú, 1200–1400 m, Dec. 1972, *J. A. Steyermark, C. Steyermark, Wurdack & Wiehler 106624* (holotype, VEN). Figure 9A.

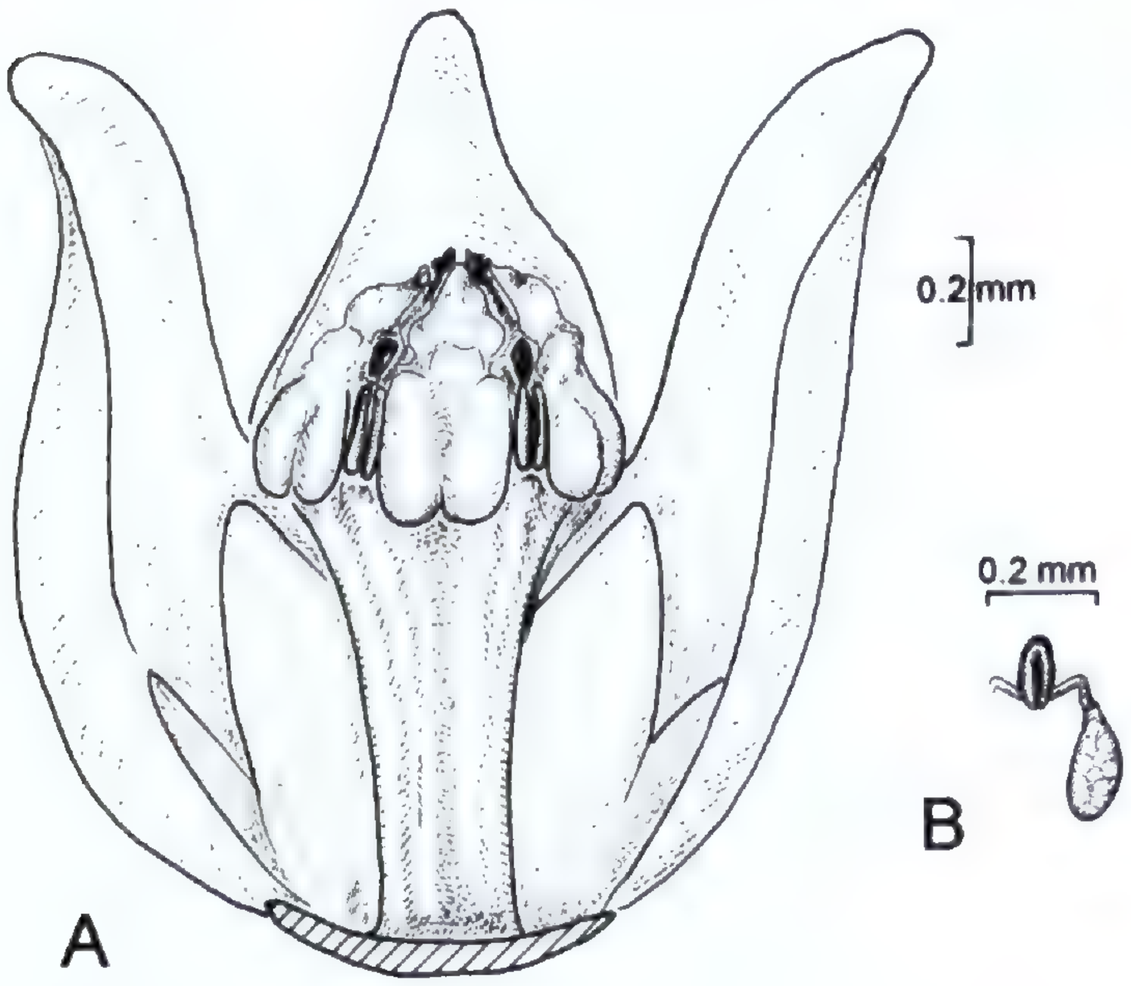


Figure 7. *Tassadia manarae* (Morillo) Liede & Meve. — A. Flower in lateral view with parts of the corolla and corona removed. —B. Pollinarium. (Drawn by U. Meve from the type, *Manara s.n.*)

Tassadia marahuacensis Morillo, Ernstia 51: 13. 1989. Syn. nov. TYPE: Venezuela. Amazonas. Cerro Marahuaca, 1140 m, Feb.–Mar. 1985, *Steyermark & Holst 130887* (holotype, VEN; isotype, MO). Figure 9B.

Tassadia marahuacensis represents a synonym of *T. kamaensis* because the two taxa agree totally not only in floral structure, but also in the characteristic long-attenuate leaf shape and almost sessile inflorescences, bostrychoid inflorescences lacking the elongation of the sympodial branch produced by the α-bract typical of most *Tassadia* species (Fig. 9; see Liede & Weberling, 1995).

Changes in Sectional Affiliation of New World *Cynanchum* Species

Liede (1997a) has identified species groups in American *Cynanchum* at the sectional level and delimited the genus from related genera. In addition, all species known at that date have been tentatively assigned to a section. In the meantime, new information on some species has become available leading to reconsideration of sectional affinity of six species, all assigned to *Cynanchum* sect. *Microphyllum.*

Cynanchum L. sect. **Microphyllum** Liede, Novon 7: 176. 1997.

Cynanchum carmenaemiliae Morillo, Ernstia 2(1–2): 4. 1992. TYPE: Venezuela. Mérida: Carretera Estanques–El Molino, 17 km S de Estanques, 1650 m, 17 Mar. 1992, *Morillo, Eriksen & Ståhl 10800* (holotype, VEN; isotype, MERF).

Liede (1997a) considered this species as a likely candidate for a transfer to *Orthosia* because of its very regular branching pattern. However, the inflorescences are clearly extra-axillary, the corona is thin and fused for more than 3/4 of its length, and the gynostegium is highly stipitate, a character combination fitting much better with *Cynanchum* sect. *Microphyllum* than with *Orthosia.*

Cynanchum confusum R. W. Holm, Fieldiana 28: 505. 1953. TYPE: Venezuela. Mérida: "La Isla" above Tabay, 2285–2745 m, 18 May 1944, *Steyermark 56586* (holotype, Chicago Natl. Hist. Mus.; isotype, NY).

Liede (1997a) had no material of *C. confusum* and could thus not determine the affinities of this species. As detailed in the protologue, this species displays a character mix precluding any definite placement. The pilose corolla lobes suggest an affinity to *Metastelma,* but no corona fused for almost 1/3 of its length has been encountered in *Metastelma* yet. If considered a *Cynanchum,* section *Microphyllum* clearly harbors the closest relatives, with *C. luteynii* Morillo even sharing adaxially pilose corolla lobes.

Cynanchum nubicola Morillo, Ernstia 2: 8. 1992. *Metastelma nubicola* (Morillo) Liede, Novon 7: 43. 1997. TYPE: Venezuela. Trujillo: carretera Carrache–La Peña, 31.5 km E de Carache, 2000–2200 m, 28 Sep. 1988, *Morillo 10543* (holotype, VEN; isotype, MERF).

The corona of *C. nubicola,* upon careful examination, is fused at the base. Together with the adaxially glabrous corolla lobes, there is no argument any more to maintain the transfer of this species to *Metastelma.* With its urceolate, highly fused corolla, its long stipe, and pronouncedly baggy anther sacks, it fits well in *Cynanchum* sect. *Microphyllum.*

Cynanchum ruizterranii Morillo, Acta Bot. Venez. 16: 66. 1993. TYPE: Venezuela. Mérida: Rivas Dávila, Páramo Batallón, entre Portachuelo y Qda. La Mogral, 2850–2900 m, 7 May 1977, *Ruiz-Terán & Usubillaga 13501* (holotype, MERF).

Cynanchum siderocalyx Morillo, Acta Bot. Venez. 16: 68. 1993. TYPE: Venezuela. Mérida: Miranda, entre Las Palmas y Las Gonzales, Páramo de Palmira, 3200–3300 m, 23 May 1975, *Ruiz-Terán & Dugarte 12226* (holotype, MERF).

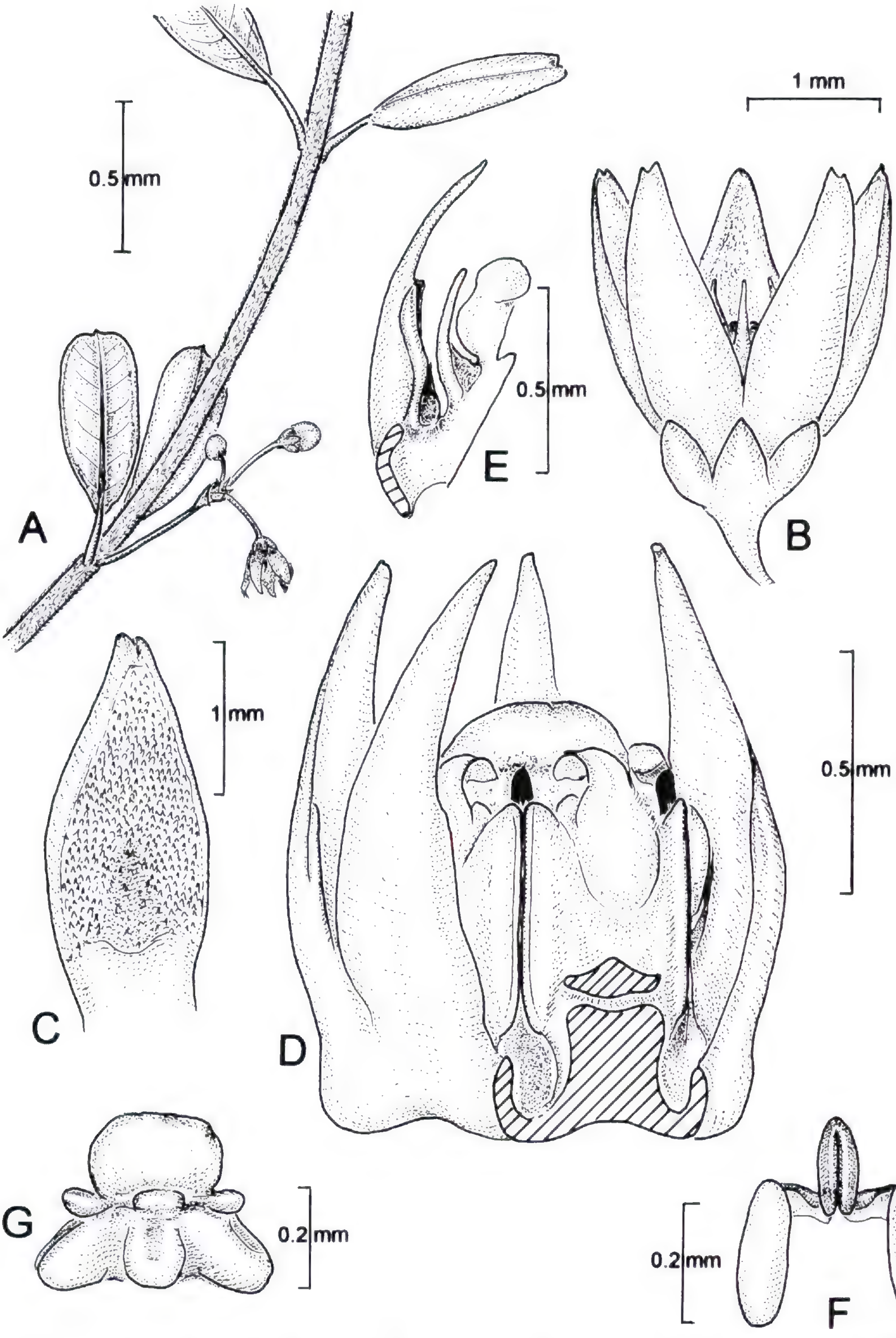


Figure 8. *Ditassa angustifolia* Decaisne. —A. Habit. —B. Flower. —C. Petal, adaxial view. —D. Corona with gynostegium. —E. Attachment of corona lobes. —F. Pollinarium. —G. Stylar head. (A–D, F from the type of *D. bolivarensis*, *Steyermark 59106*. E, G from the type of *D. angustifolia*, *Schomburgk 627*; executed by U. Meve from pencil drawings by J. Conrad.)

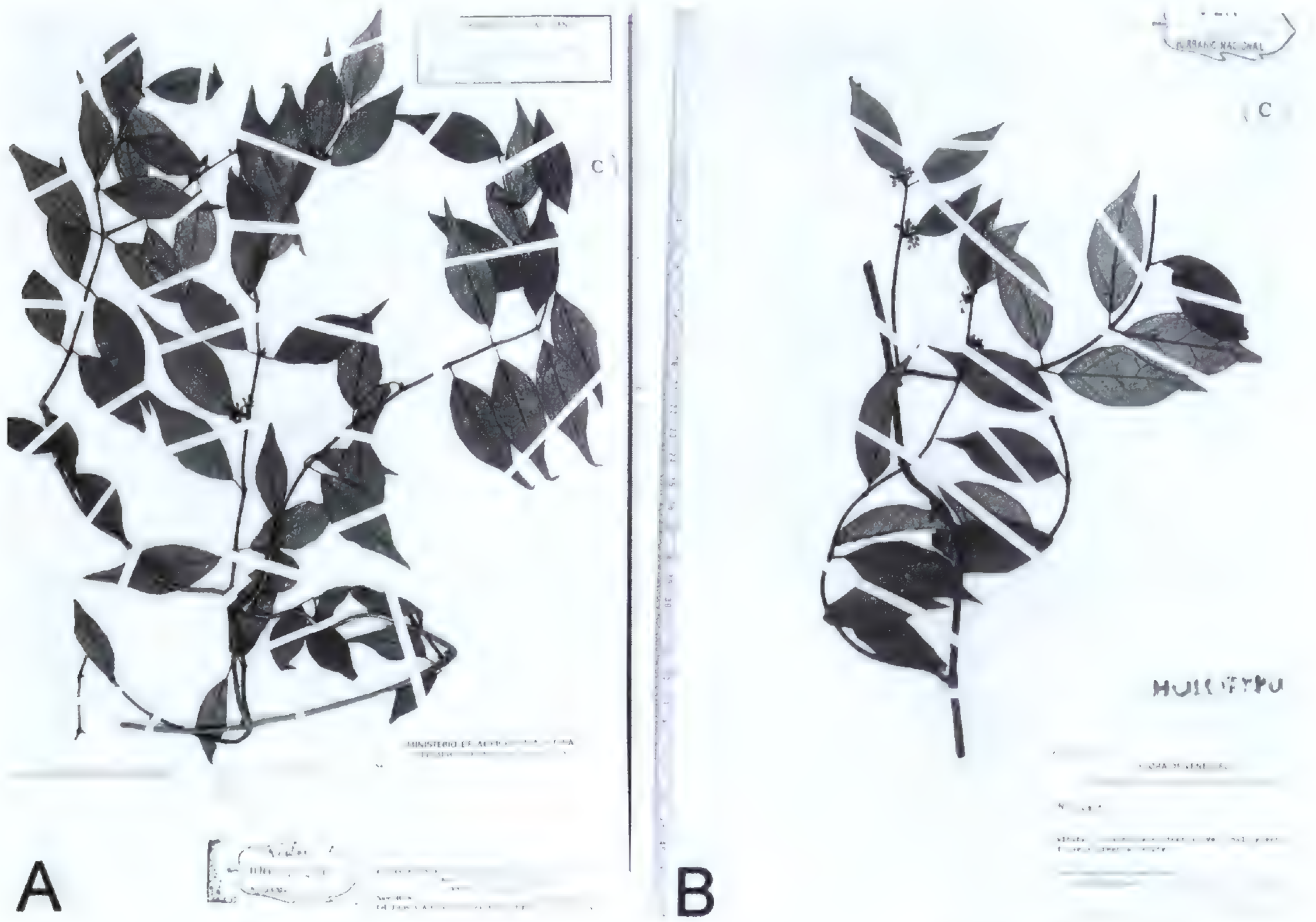


Figure 9. *Tassadia kamaensis* (Morillo) Morillo. —A. Holotype of *T. kamaensis, Steyermark et al. 106624.*—B. Holotype of *T. marahuacensis* Morillo, *Steyermark & Holst 130887.*

Both *Cynanchum ruizterranii* and *C. siderocalyx* had been unknown to Liede (1997a). The two species are extremely similar, and more material might prove them conspecific. The small leaves, rich-flowered, sciadioidal inflorescences, glabrous corolla lobes, basally fused gynostegial corona, and highly stipitate gynostegium leave no doubt as to their sectional affiliation in *Cynanchum* sect. *Microphyllum.*

Cynanchum violator R. W. Holm, Fieldiana 28: 509. 1953. TYPE: Venezuela. Táchira: between Betania and Tamá, 2430 m, 13 July 1944, *Steyermark 57190* (holotype, Chicago Natl. Hist. Mus.; isotype, NY).

Cynanchum violator, like *C. confusum,* is one of those species combining several characters commonly used for sectional or even generic delimitation. Its reddish, glabrous corolla, and the equally reddish, very short, fleshy and almost annular corona are distinctly reminiscent of *Orthosia.* However, the long-pedunculate, lax and branched inflorescences, and the single, fusiform fruits suggest that it is a member of *Cynanchum* sect. *Microphyllum.*

Acknowledgments. Thanks are due to the directors of A, AAU, F, GB, M, MO, NY, P, S, SI, UPS, and VEN for large long-term loans of South American Metastelminae. The director of MERF is acknowledged for permission to study specimens on site. Otto Huber, Caracas, and Gilberto Morillo, Mérida, have been very helpful during our herbarium visits in Venezuela. Ralf Omlor, Mainz, has been a stimulating critic of generic concepts.

Literature Cited

Fontella Pereira, J. 1970. Contribuição ao estudo das Asclepiadaceae brasileiras, VI. Novas combinações e novos sinônimos. Loefgrenia 43: 1–3.

———. 1994. Estudos em Asclepiadaceae, XXIX. Espécies novas da caatinga e novas combinações em *Petalostelma.* Pabstia 5: 4–6.

——— & E. A. Schwarz. 1982. Estudos em Asclepiadaceae 25. Chave para as espécies do gênero *Jobinia* Fournier ocorrentes no Brasil. Bol. Mus. Mun. (Curitiba) 51: 1–18.

Fournier, E. 1885. Asclepiadaceae. Pp. 192–298 *in* C. F. P. v. Martius (editor), Flora Brasiliensis Vol. 6, 4. [Cramer, Lehre, Reprint, 1967.]

Hewson, H. J. 1988. Plant Indumentum—A Handbook of Terminology. Australian Flora and Fauna Series 2: 1–27.

Liede, S. 1996a. *Cynanchum–Rhodostegiella–Vincetoxicum–Tylophora*: New considerations on an old problem. Taxon 45: 193–211.

———. 1996b. Anther differentiation in the Asclepia-

daceae: Form and function. Pp. 221–235 *in* W. G. D'Arcy & R. C. Keating (editors), The Anther: Form, Function and Phylogeny. Cambridge Univ. Press, Cambridge.

———. 1997a. American *Cynanchum* (Asclepiadaceae)—A preliminary infrageneric classification. Novon 7: 172–181.

———. 1997b. Subtribes and genera of the tribe Asclepiadeae (Apocynaceae–Asclepiadoideae)—A synopsis. Taxon 46: 233–247.

——— & H. Kunze. 1993. A descriptive system for corona analysis in Asclepiadaceae and Periplocaceae. Pl. Syst. Evol. 185: 275–284.

——— & U. Meve. 1997. Some clarifications, new species and new combinations in American *Cynanchum.* Novon 7: 38–45.

——— & F. Weberling. 1995. Inflorescence structure in Asclepiadaceae. Pl. Syst. Evol. 197: 99–109.

Malme, G. O. A. N. 1928. Über paarige extraaxilläre Infloreszenzen bei den Asklepiadazeen. Svensk Bot. Tidskr. 22: 49–56.

———. 1932. Asclepiadaceae austroamericanae praecipue andinae. Ark. Bot. 25A(7): 1–26, tab. 1–3.

———. 1934. Asclepiadaceae argentinae. Ark. Bot. 26A(4): 1–45.

Meyer, T. 1944. Asclepiadaceae. Pp. 1–273 *in* H. R. Descole (editor), Genera et Species Plantarum Argentinarum 2. G. Kraft, Buenos Aires.

Morillo, G. 1989. Contribución al conocimento de las Asclepiadaceae suramericanas, prinicipalmente de las Guyanas. Ernstia 51: 1–16.

———. 1992. New species and new combinations in the Andean *Cynanchum* and *Matelea* (Asclepiadaceae). Ernstia 2: 59–72.

———. 1997. Asclepiadaeae. Pp. 129–177 *in* J. A. Steyermark, P. E. Berry & B. K. Holst (editors), Flora of the Venezuelan Guyana, Vol. 3. Missouri Botanical Garden Press, St. Louis.

Schwarz, E. A. & J. Fontella Pereira. 1995. O gênero *Jobinia* Fournier (Asclepiadaceae) no Brasil. Acta Biol. Par. 24: 49–157.

Sundell, E. 1981. The New World species of *Cynanchum* subgenus *Mellichampia* (Asclepiadaceae). Evol. Monogr. 5: 1–62.

Woodson, R. E. 1941. The North American Asclepiadaceae. Ann. Missouri Bot. Gard. 28: 193–244.

Dos Especies Nuevas de *Ocotea* (Lauraceae) del Sur de México

Francisco G. Lorea Hernández
Instituto de Ecología, A. C., Apdo. Postal 63, 91000 Xalapa, Veracruz, México

RESUMEN. Se describen e ilustran dos especies nuevas del género *Ocotea* del sur de México: *O. candidovillosa* y *O. sauroderma*. La primera, un nuevo miembro del grupo de *Ocotea helicterifolia* (Meissner) Hemsley, se distingue por la presencia de tricomas rectos y erectos a lo largo de las venas en el envés de las hojas, inflorescencias tirsiformes tomentosas, flores tomentosas y pedículos de las glándulas de los estambres del verticilo III unidos a los filamentos de los estaminodios. La segunda, una especie sin claras relaciones con algún grupo particular dentro de *Ocotea*, se diferencia por tener hojas rugosas densamente rufo-tomentosas en el envés, un par de venas foliares marginales, inflorescencias rufo-tomentosas, flores tomentosas y estaminodios con un par de glándulas en el pedículo.

ABSTRACT. *Ocotea candidovillosa* and *O. sauroderma*, two new Lauraceae from southern Mexico, are described and illustrated. The former, a new member of the *O. helicterifolia* (Meissner) Hemsley group, is distinguished by the presence of straight and erect trichomes only along veins on the undersurface of leaves, tomentose thyrsiform inflorescences, tomentose flowers, and stalk of glands from stamens of whorl III fused to filaments of staminodes. The latter, a species without a clear relationship to any group within *Ocotea*, is recognized by its rugous leaves, densely rufo-tomentose below, a pair of marginal foliar veins, rufo-tomentose inflorescences, tomentose flowers, and staminodes with a pair of glands on their filaments.

Key words: Lauraceae, Mexico, *Ocotea*.

La continua revisión de material herborizado de la familia Lauraceae procedente de México, en particular de especímenes recientemente colectados, ha ayudado de manera importante a conocer mejor la dimensión de la diversidad de esta familia en esta región del mundo. Al mismo tiempo que se está resolviendo la aplicación correcta de varios nombres taxonómicos, ha sido posible la detección de varias especies que, aunque recolectadas hace varias décadas, han quedado incorporadas en los herbarios mal identificadas. Aquí se presenta el caso de dos especies del género *Ocotea*.

De acuerdo a la caracterización presente del género, la inclusión de estos dos nuevos taxa en *Ocotea* es indudable. Los dos tienen flores y frutos con los rasgos generales distintivos del grupo: tépalos no papilosos en su cara interna, nueve estambres fértiles con cuatro esporangios cada uno, esporangios dispuestos en dos pares, estaminodios presentes mas no con ápice glandular bien desarrollado, hipantio evidente y cúpula del fruto sin tépalos en su borde. En México son conocidas cerca de 20 especies de *Ocotea*. La mayoría de ellas se presentan en la mitad sur del país, principalmente en los estados de Veracruz, Oaxaca y Chiapas, formando parte de los bosques húmedos tropicales y templados de las zonas montañosas.

Ocotea candidovillosa Lorea-Hernández, sp. nov.

TIPO: México. Guerrero: mpio. Leonardo Bravo (Chichihualco), Puerto Soleares, aprox. 5.5 km al SE de El Carrizal, 2640 m, 3 Mar. 1984 (fl), *F. Lorea 2972* (holótipo, XAL; isótipos, MO, XAL). Figura 1.

Arbores; ramulis dense tomentosis. Folia elliptica, oblonga vel oblanceolata, apice cuspidato vel acuminato, base obtusa saepe leviter obliqua, lamina supra non nisi secus venas villosa vel glabrata, infra non nisi secus venas trichomatibus candidis persistentibus villosa. Inflorescentia thyrsiformis, cymis partialibus tomentosis, simplicibus vel geminatis constans. Flos ut videtur rotatus, bisexualis; tepalis extus lanuginosis, intus sericeis; staminibus novem, antheris verticillis secundi incumbentibus; staminodiis manifestis, filamentis ad glandulas staminum verticilli tertii adnatis; hypanthio profundo. Fructus cupula crateriformi vel patelliformi subtentus.

Árboles de (4–)10–20 m. Tronco de color pardo grisáceo oscuro o grisáceo; ramillas densamente tomentosas, tricomas de 0.3–0.5 mm de largo, extendidos, ondulados, persistentes, de color amarillo a leonados; pecíolo (12–)17–25(–36) × (1.4–)1.8–2.2(–2.6) mm, tomentoso, tricomas como en las ramillas; lámina foliar de (8–)15–22(–25) × (4.5)6–8.5(–10.5) cm, elíptica u oblonga a oblanceolada, base obtusa o redondeada, con frecuencia ligeramente oblicua, ápice cuspidado a acuminado, haz vellosa, los tricomas sólo en las venas, glabrescentes con la edad, envés velloso, los tricomas erectos, rectos, blancos, brillantes, restringidos a la vena media y venas de segundo a cuarto orden, persistentes, vena media levemente hundida adaxial-

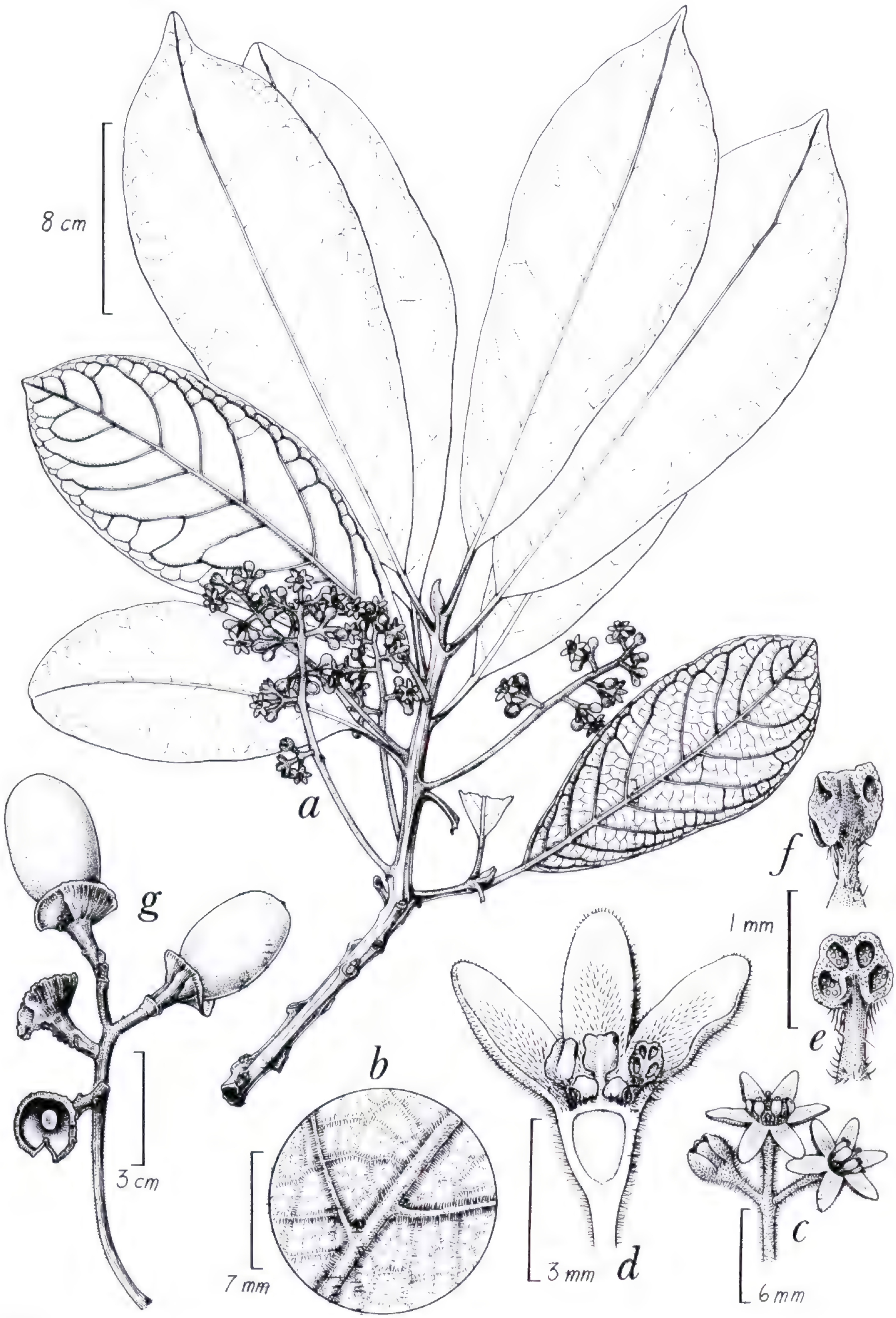


Figura 1. *Ocotea candidovillosa* Lorea-Hernández. —a. Vista general de una ramilla. —b. Detalle de la pubescencia en el envés de las hojas. —c. Parte terminal de una división de la inflorescencia. —d. Detalle del interior de una flor. —e. Vista adaxial de un estambre del verticilo exterior. —f. Vista adaxial de un estambre del verticilo III. —g. Infrutescencia con frutos maduros.

mente, elevada abaxialmente, venas secundarias (7–)10–12(–15) pares, planas adaxialmente, ligeramente elevadas abaxialmente, venas terciarias distintas, planas adaxialmente, ligeramente elevadas abaxialmente; inflorescencia de (4–)7.5–14(–18.5) cm de largo, en la axila de las hojas o de brácteas deciduas en la base de los brotes nuevos, tirsoide, las secciones de la inflorescencia de cimas simples o en ocasiones de dos cimas, pedúnculo de (2.5–)4–6(–7.5) cm de largo, densamente tomentoso, los otros ejes de la inflorescencia también tomentosos, pedicelo floral de (3–)4.5–6.5(–8.5) mm de largo, tomentoso; flor más bien rotada, blanca o blanca verdosa, tépalos de 3.3–4.5 × 2–2.6 mm, más o menos carnosos, los externos angostamente ovados u ovados, los internos ovados, todos lanosos por fuera, al menos en su parte central, seríceos por dentro, reflejos al final de la antesis, marcescentes, estambres de los verticilos I y II de 1.3–1.7 mm de largo, filamentos esparcidamente pilosos adaxial y abaxialmente o glabrescente adaxialmente, anteras de 0.7–0.9 mm de largo, glabras, laminares, las del verticilo II incumbentes, esporangios cuatro, en dos pares oblicuos, introrsos, estambres del verticilo III de 1.4–1.7 mm de largo, filamentos glabros adaxialmente, más o menos pilosos abaxialmente, anteras de 0.6–0.8 mm de largo, glabras, esporangios cuatro, en dos pares casi paralelos, los superiores latrorsos, los inferiores introrso-latrorsos, glándulas de 0.5–0.8 mm de largo, más o menos orbiculares, de superficie angulosa, glabras, cortamente pediculadas, el pedículo fusionado al filamento del estaminodio y a la base del estambre III, formando un anillo de ca. de 0.3 mm de alto, estaminodios de 0.8–1.2 mm de largo, filamento glabro adaxialmente, más o menos piloso abaxialmente, ápice de 0.5–0.7 mm de largo, ovado a angostamente triangular, levemente conduplicado, aquillado abaxialmente, glabro, hipantio de 0.7–0.9 mm de profundidad, velloso-lanoso por fuera, glabro por dentro, pistilo de 2.6–3.5 mm de largo, glabro, ovario de 1.4–2.2 mm de largo; fruto de 25–29 × 16–19 mm, elipsoidal, asentado en el hipantio agrandado, de 4–6 mm de largo, por 13–16 mm de diámetro, crateriforme o pateliforme, leñoso, tépalos no persistentes en el fruto maduro, pedicelo engrosado, de 5–10 × 4–5.5 mm, leñoso.

Los bosques templados húmedos de pino-encino y mesófilo de montaña, son la vegetación que domina el hábitat de *Ocotea candidovillosa*; particularmente las zonas donde se presentan *Abies* y/o *Chiranthodendron.* Además de *Pinus* y *Quercus,* otros géneros que acompañan a *O. candidovillosa* son *Clethra, Cleyera, Fuchsia, Ostrya* y *Persea.* El intervalo de altitud en el que se le puede encontrar abarca de los 2100 a 2875 m, pero es común entre los 2450 y 2600 m.

La época de floración es corta, de fines de Febrero a fines de Abril. Los frutos al parecer tardan un año en madurar, pues se presentan por lo general junto con las flores; los frutos jóvenes se encuentran todo el resto del año.

Las características de *O. candidovillosa,* en particular los largos tricomas rectos y erectos en el envés de las hojas, claramente la ubican dentro del grupo de especies centrado en *O. helicterifolia* (sensu Rohwer, 1986, 1991). Sin embargo, las flores con tépalos densamente lanosos por su cara externa apartan a *O. candidovillosa* del núcleo de ese grupo de especies. Tomando como punto de relación a este carácter, los taxa más afines con la nueva especie son los reconocidos actualmente bajo *Ocotea purpurea* (Mez) van der Werff y *O. tonii* (Lundell) van der Werff. Las diferencias principales con *O. candidovillosa* son que en las dos especies citadas los tricomas del envés de la hoja se encuentran distribuidos homogéneamente y que los pedículos de las glándulas del verticilo estaminal III no están unidos a los filamentos de los estaminodios, en tanto que en *O. candidovillosa* los tricomas del envés de la hoja se encuentran sólo a lo largo de las venas y venillas, y las glándulas del verticilo estaminal III se hallan unidas a los estaminodios por los filamentos formando un anillo. En adición a estas discrepancias, *O. purpurea* tiene las cimas parciales de la inflorescencia aglomeradas y *O. tonii* presenta anteras de los verticilos I y II subsésiles, estaminodios clavados, y esporangios de los estambres del verticilo III todos latrorsos. Por su parte, *O. candidovillosa* presenta inflorescencias con cimas parciales distintas, anteras de los verticilos I y II evidentemente pediceladas, estaminodios capitados, y anteras del verticilo III con los esporangios superiores latrorsos y los inferiores extrorso-latrorsos.

El conjunto de caracteres que distingue a *O. candidovillosa* no se encuentra en ninguno de los miembros del grupo de *O. helicterifolia* (van der Werff, 1999) y, conforme a lo observado en varios ejemplares de herbario, no son extremos de variación de rasgos encontrados en otros taxa del grupo. Por consiguiente, se considera que las diferencias halladas en *O. candidovillosa* ameritan el reconocimiento específico. El nombre hace alusión a la apariencia llamativa blanco-tomentosa de las venas en el envés de las hojas.

Parátipos. MÉXICO. **Guerrero:** mpio. Leonardo Bravo (Chichihualco), 6 km al NE de Cruz de Ocote, (fr), *E. Velázquez 200* (FCME, XAL); 3 km al NE de Cruz de

Ocote, (fr), *F. Lorea 4089* (FCME, XAL); 3.5 km al NE de Cruz de Ocote, (fr), *F. Lorea 5490* (XAL), *F. Lorea 3458* (FCME, XAL); km 18 del camino Carrizal de Bravo a Puerto del Gallo, (fr), *R. Fonseca 275* (MEXU); Puerto Soleares, 7 km de Carrizal de Bravo, (fl), *R. Fonseca 2432* (FCME, XAL); mpio. Malinaltepec, 4 km al SE de Paraje Montero, (fl), *M. Muñoz 173* (FCME, XAL); mpio. Heliodoro Castillo (Tlacotepec), aserradero Agua Fría, cerca del Cerro Tlacotepec, (fl), *J. Rzedowski 16484* (MEXU, MICH); Agua Fría, cerca del aserradero, (fr), *N. Diego et al. 7739* (FCME, XAL); Agua Fría, (fr), *N. Diego et al. 7924* (FCME, XAL), Agua Fría, (fl, fr), *N. Diego et al. 7715* (FCME, XAL), Agua Fría, (fl), *N. Diego et al. 7850* (FCME, XAL); ladera E del Cerro Teotepec, camino Filo de Caballos a Atoyac, (fr), *D. Breedlove & F. Almeda 65013* (MEXU); ca. El Jilguero, camino Filo de Caballos a Atoyac, (fr), *J. Soto et al. 5835* (F, MEXU); km 8 del camino La Guitarra a Toro Muerto, (fl), *F. Lorea 2292* (FCME, XAL); km 9 del camino Puerto El Jilguero a Puerto del Gallo, (fl), *F. Lorea 2399* (FCME, XAL). **Oaxaca:** distrito Juxtlahuaca, mpio. Santiago Juxtlahuaca, El Manzanal, torre de microondas, (fr), *I. Calzada 20968* (TEX, XAL); mpio. Santiago Juxtlahuaca, Puerta de la Luz, (fr), *I. Calzada 19803* (TEX, XAL), (fl) *I. Calzada 19811*; mpio. Santiago Juxtlahuaca, 6 km de San Pedro Chayuco, camino al aserradero, (fr), *I. Calzada 19788* (TEX, XAL); mpio San Martín Peras, 1 km de la desv. a La Escopeta, camino Santiago Juxtlahuaca–San Martín Peras, (fl), *I. Calzada 20850* (TEX, XAL).

Ocotea sauroderma Lorea-Hernández, sp. nov. TIPO: México. Oaxaca: distrito Tuxtepec, mpio. San Felipe Usila, 8 km al S de Santa Cruz Tepetotutla, 1920 m, 31 Oct. 1994 (fl), *A. Rincón, C. Gallardo & R. Wong 493* (holótipo, XAL; isótipos, MEXU, MO, XAL). Figura 2.

Arbores; ramulis villosis. Folia anguste elliptica, raro elliptica vel leviter obovata, magna, coriacea, apice acuminato, base obtusa saepe obliqua, lamina supra rugosa, glabra, infra trichomatibus ferrugineis dense lanuginosa. Inflorescentia ex cymis dense lanatis in thyrsum aggregatis constans. Flos ut videtur rotatus, bisexualis; tepalis extus dense lanuginosis, intus sericeis pro dimidio inferno; staminibus novem, sex externis geniculatis, tribus internis leviter reflexis; staminodiis manifestis, filamentis biglandulosis; hypanthio non profundo. Fructus cupula patelliformi subtentus.

Árboles de 15–25 m. Tronco de color pardo claro; ramillas densamente lanoso-vellosas, tricomas de (0.5–)0.7–1 mm de largo, erectos, algo ondulados, pardo rojizos; pecíolo de (20–)31–52 × (1.8–)2–2.8(–3.3) mm, densamente lanoso-velloso, tricomas como en las ramillas; lámina foliar de (12–)16.5–25(–35) × 4.5–8(–10.5) cm, angostamente elíptica, a veces elíptica o ligeramente obovada, coriácea, base obtusa, con frecuencia oblicua, ápice acuminado o agudo, haz rugosa, glabra, envés densamente lanoso-velloso, tricomas como en las ramillas, vena media plana, mas aparentemente elevada por estar densamente lanosa-vellosa por arriba, elevada y densamente lanoso-vellosa por abajo, venas secundarias 8–11 pares, con un par basal marginal, planas a ligeramente hundidas por arriba, apareciendo algo elevadas por estar densamente lanoso-vellosas, a veces glabrescentes, elevadas y densamente lanoso-vellosas por abajo, venas terciarias hundidas por arriba, glabrescentes o glabras, elevadas y densamente lanoso-vellosas por abajo; inflorescencia de (10–)12–20(–25) cm de largo, en la axila de las hojas, o de brácteas gruesas y pequeñas, dispuestas en brotes cortos, o inmediatamente abajo de las yemas terminales de las ramillas, cimoso-paniculadas, pedúnculo de 2–7 cm de largo, o ausente, densamente lanoso-velloso, pedicelo floral de 1.8–2.5(–3.2) mm de largo, densamente lanoso-velloso; flor más bien rotada, de color amarillo pálido, tépalos de 3.4–4.5 × 1.4–1.6 mm, angostamente elípticos o angostamente oblongos, densamente lanoso-vellosos por fuera, los más internos glabros en el ápice o en toda su mitad superior, todos seríceos en menor o mayor grado en su mitad inferior por dentro, glabros en el resto de su superficie, extendidos y ligeramente reflejos al término de la antesis, estambres de los verticilos I y II de ca. 1.7 mm de largo, filamentos vellosos adaxial y abaxialmente, anteras de ca. 1 mm de largo, glabras, cuadrangulares, laminares, dobladas hacia adelante justo en su base, esporangios cuatro por antera, en pares oblicuos, introrsos, estambres del verticilo III de 1.6–1.8 mm de largo, filamentos glabros adaxialmente, vellosos abaxialmente, anteras de 0.7–0.8 mm de largo, glabras, prismáticas, ligeramente dobladas hacia atrás, esporangios cuatro, en pares, los superiores latrorsos, los inferiores latrorso-extrorsos, glándulas de 0.6–0.7 mm de largo, oblongas a redondeadas, con superficie muy irregular, ubicadas a los lados de la base del filamento, glabras o algo vellosas adaxialmente en su punto de inserción, estaminodios del cuarto verticilo de ca. 1 mm de largo, filamento glabro o ligeramente velloso adaxialmente, velloso abaxialmente, con un par de glándulas oblongas ubicadas cerca de su parte media, ápice terminando en una punta trunca de forma triangular, o sin forma, apenas algo más ancho que el filamento o del mismo ancho que este, aparentemente glandular, hipantio de 0.7–1 mm de profundidad, cotiliforme o crateriforme, densamente lanoso-velloso por fuera, glabro o glabrescente por dentro, pistilo de 2.8–3.3 mm de largo, glabro, ovario de 1.3–2 mm de largo; fruto de 21–24 × 13–15 mm, elipsoidal, asentado en el hipantio ligeramente acrescente, de 3–4.5 × 12–13 mm, tépalos no persistentes en el fruto, pedicelo engrosado, de 7–10 × 2.2–3.2 mm, glabrescente o glabro.

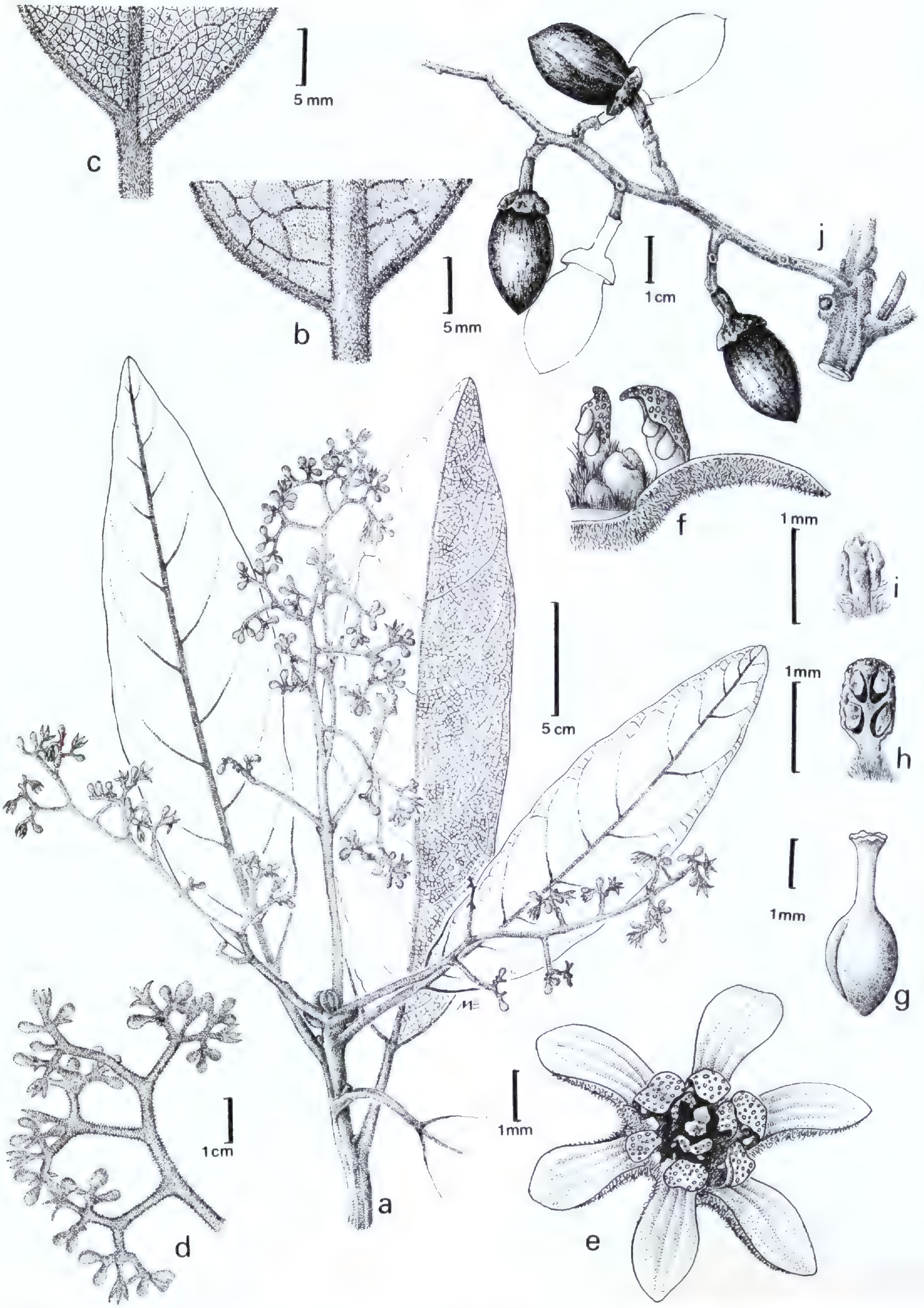


Figura 2. *Ocotea sauroderma* Lorea-Hernández. —a. Vista general de una ramilla. —b. Detalle de la base de una hoja por el envés. —c. Detalle de la base de una hoja por la haz. —d. Parte terminal de una división de la inflorescencia. —e. Detalle de una flor. —f. Detalle del interior de una flor, mostrando un estambre del verticilo I, un estambre del verticilo III y el ápice de un estaminodio. —g. Pistilo. —h. Vista adaxial de un estambre del verticilo exterior. —i. Vista abaxial de un estaminodio mostrando el par de glándulas en el filamento. —j. Grupo de frutos maduros.

El tipo de vegetación donde se ha encontrado hasta ahora a *O. sauroderma* es el bosque mesófilo de montaña, donde es acompañado por árboles de los géneros *Bejaria, Clethra, Cleyera, Miconia, Persea, Rapanea, Ticodendron, Vaccinium, Viburnum* y *Zinowiewia*, entre otros. El intervalo de altitud en que prospera va de los 1650 a 2000 m.

La época de floración, de fines de Octubre a fines de Diciembre, contrasta con la de la mayoría de las especies de Lauraceae y de otras familias en el mismo bosque. De igual forma, los frutos maduros toman alrededor de un año en madurar, pues se encuentran junto con las flores nuevas en los mismos meses.

La morfología general de *Ocotea sauroderma* es muy cercana a lo que hasta ahora ha sido conocido como *Phoebe amplifolia* Mez (= *Ocotea* sp.). Mas la presencia consistente de un par de venas foliares marginales, tépalos no papilosos por dentro, anteras del verticilo III con esporangios basales extrorsos, y estaminodios con un par de glándulas en su filamento separan a *O. sauroderma* de *P. amplifolia*, que tiene hojas sin venas marginales, tépalos papilosos por dentro, estambres del verticilo III con todos los esporangios latrorsos, y estaminodios sin glándulas en su filamento.

Siguiendo la revisión preliminar que Rohwer (1986) realizó del género *Ocotea*, la clave sugiere cierta cercanía de *O. sauroderma* con *Phoebe salvadorensis* (Lundell) Lundell. Sin embargo, es evidente la gran diferencia morfológica entre estas dos especies: las hojas son lanceoladas o lanceolado-elípticas, pequeñas y blanco tomentosas por el envés en *P. salvadorensis*, en tanto que en *O. sauroderma* las hojas son mayormente elípticas, grandes y rufo-tomentosas en el envés. Además se refiere a las características mencionadas en el párrafo anterior.

No existe especie alguna en el sur de México o Centroamérica con las características que distinguen a *O. sauroderma* por lo que sus relaciones no son claras. El nombre específico hace referencia al aspecto y tacto que tienen las hojas en su haz; son literalmente la piel de un lagarto.

Parátipos. MÉXICO. **Oaxaca:** distrito Ixtlán, mpio. Ixtlán de Juárez, Cerro El Chapulín, (fl), *Y. Arellanes et al. 409* (XAL); 6 km NNE del poblado La Luz, (fl), *B. Boyle et al. 3862* (MEXU, MO); distrito Tuxtepec, mpio. San Felipe Usila, 5.6 km al S de Santa Cruz Tepetotutla, (fl), *A. Rincón et al. 231* (MEXU, XAL); 6 km al S de Santa Cruz Tepetotutla, (fl, fr), *J. Meave 2050* (MEXU, XAL).

Agradecimientos. Quiero agradecer a los colectores de las muestras más recientes su particular interés en obtener muestras de buena calidad para la descripción de las especies referidas. Igualmente, deseo hacer un reconocimiento más a la labor de E. Saavedra (Fig. 1) y M. Escamilla (Fig. 2), quienes proporcionaron las ilustraciones correspondientes a este trabajo. También agradezco a los revisores anónimos sus comentarios, particularmente al que corrigió los errores de las descripciones latinas.

Literatura Citada

Rohwer, J. 1986. Prodromus einer Monographie der Gattung *Ocotea* Aubl. (Lauraceae), sensu lato. Mitt. Inst. Allg. Bot. Hamburg 20: 1–278.

———. 1991. Borderline cases between *Ocotea, Nectandra*, and *Phoebe* (Lauraceae): The "marginal" species of the *Ocotea helicterifolia*-group, including the *O. heydeana*-group. Bot. Jahrb. Syst. 112: 365–397.

Werff, H. van der. 1999. New taxa and combinations in the *Ocotea helicterifolia* (Lauraceae) species group. Novon 9: 571–583.

Typification of Two Linnaean Species Names of the Genus *Thlaspi* (Brassicaceae)

Karol Marhold
Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 14, SK-842 23 Bratislava, Slovak Republic

Pavol Mártonfi
Department of Experimental Botany & Genetics, Faculty of Science, P. J. Šafárik University, Mánesova 23, SK-041 54 Košice, Slovak Republic

ABSTRACT. Lectotypification of the name *Thlaspi alliaceum* L., with a Bauhin illustration from *Historia plantarum*, and *T. montanum* L., with a specimen from the LINN herbarium, is presented.

Key words: Brassicaceae, lectotypification, Slovakia, *Thlaspi*.

During the writing of the account of the genus *Thlaspi* for the *Flora of Slovakia* [*Flóra Slovenska*] by the second author, it became apparent that the following two Linnaean names require lectotypification in order to fix their application:

Thlaspi alliaceum L., Sp. Pl.: 646, 1753. TYPE: Bauhin, J., J. H. Cherler & D. Chabrey, Hist. Pl. 2: 932 ("SCORODOTHLASPI ULYSSIS / Aldroandi"), 1651 (lectotype, selected here).

The diagnostic phrase-name is referred directly to van Royen's *Florae Leydensis Prodromus* (1740). There is, however, no extant, associated van Royen specimen at Leiden (L), and no relevant extant material has been traced in any of the Linnaean herbaria. There are two illustrations cited in the protologue that comprise the original material: the first is in Bauhin et al. (1651) and the second in Morison (1680). A more detailed study of Morison's illustration entitled "28. Thlaspi Allium redolens nobis / Scorodothlaspi Ulißis Aldroandi / I. B." ["/" indicates here and in other cases a separate line], with "I.B." clearly referring to J. Bauhin, reveals that the illustration is redrawn from Bauhin et al. (1651: 932). The accompanying morphological description in Morison (1680: 297) repeats word by word the description by Bauhin et al. (1651: 932–933).

The illustration in Bauhin et al. (1651: 932 "SCORODOTHLASPI ULYSSIS / Aldroandi", Fig. 1) corresponds well to the present concept of *T. alliaceum* (e.g., Clapham & Akeroyd, 1993: 385). Lower cauline leaves are obovate, petiolate, obtusely dentate; upper ones are lanceolate-ovate. Flowers as depicted are small, and anthers are shorter than the petals. Siliculae are narrowly obovate, with narrow wings, convex beneath, and the style is not visible (this corresponds to style length in this taxon, which is usually 0.3 mm and included within the shallow notch). Fruit pedicels are more or less horizontally spreading, longer than fruits. The pubescence of the basal part of the stem is not shown, but the lack of this character does not influence the taxonomic interpretation of the depicted plant. There is no reference to the distribution area of the depicted plant, only a reference to its origin as "Montbelgardi in horto Ill. C. Wirt . . ." This, however, refers to the plant in cultivation. According to current knowledge, this species occurs in central and southern Europe, from the Iberian Peninsula and France in the west to Bulgaria and European Turkey in the east (see Jalas et al., 1996: 144), which is in agreement with the protologue (Linnaeus, 1753: 646).

The above-mentioned illustration in Morison (1680) is considerably simplified and idealized in comparison with Bauhin's. Three separately depicted details from the Bauhin plate are missing in the Morison illustration, and unlike the Bauhin figure, which depicts different parts of the inflorescence in the proper ontogenetic stages, the Morison plate erroneously shows all siliquae in the same ontogenetic stage and all flowers in the same stage of flowering. Such stylization of flowers is also apparent in other figures of plants of the family Brassicaceae in Morison's work. Therefore, we unequivocally prefer the Bauhin illustration as the lectotype.

Thlaspi montanum L., Sp. Pl.: 647, 1753. TYPE: LINN 825.10 (lectotype, selected here).

Figure 1. Illustration entitled "SCORODOTHLASPI ULYSSIS / Aldroandi" by Bauhin et al. (1651: 932), designated here as a lectotype of the name *Thlaspi alliaceum* (courtesy of The Natural History Museum, London).

The diagnostic phrase-name is Linnaeus's own, and there are four synonyms cited in the protologue. Two of them (by Clusius, 1601: 131, and by Columna, 1606: 275) are cited together with illustrations that should be considered in lectotypification. The Clusius illustration bears the name "Thlaspi montanum II" and is further referred to in the text (Clusius, 1601: 130–131) as "Thlaspi montanum / II. Thlaspi Badense." The distribution is given as "Provenit in declivi montis illius glabri, qui urbi Badensi [Baden, SSW of Vienna] (in qua calidaru aquarum sunt scaturigines) imminet, quarto à Viennâ miliari," which fits the current distribution area of *T. montanum*. The illustration by Columna (1606: 276) bears the name "Thlaspi montan: [sic!] bursae pastoris fructu primum" and is referred to in the accompanying text as "Thlaspi montanum Bursae' pastoris fructu." Linnaeus (1753: 647) referred to the illustration and text as "Thlaspi montanum, bursae pastoris folio," which was corrected in the second edition of *Species Plantarum* (Linnaeus, 1763: 902) to "Thlaspi montanum, bursae pastoris fructu." The provenance is given as "Matesii montis . . . *la Vedetta* . . . " [we have not been able, however, to identify this location]. Both illustrations correspond well to the present concept of *T. montanum* (e.g., Clapham & Akeroyd, 1993: 387). The plants have a basal rosette of obovate leaves with blades abruptly narrowed to petioles. Stem leaves are on both figures, oblong-ovate, with rounded auriculae on the amplexicaul base. In Clusius's figure one stem is branched, which might occur in this species although it is not a common feature. Inflorescences are semiglobular (illustration by Columna), elongated in fruit (illustration by Clusius). Siliquae on both figures are obovate, broadly winged, with wings rounded at the tip. Styles are evident, exserting the tip of wings. No relevant material associated with the other two synonyms cited in the protologue exists. No Burser specimen associated with Bauhin's *Pinax* (Bauhin, 1623) can be traced, and neither this work nor the work by de Sauvages (1751) contains any relevant plates.

There are two specimens in the Linnaean herbarium (LINN) that bear (or originally bore) the number "8" on the bottom of the sheet, corresponding to the number of *T. montanum* in the first edition of *Species Plantarum* (Linnaeus, 1753: 647). The presence of the relevant *Species Plantarum* number, either with or without the relevant epithet in the hand of Linnaeus, has previously been shown to indicate that the material was in the possession of Linnaeus in 1753 prior to writing the specific accounts. Both of these specimens can therefore be considered original material eligible for the purpose of lectotypification. The first of these specimens (LINN 825.14) originally had the inscription "8" on the bottom of the sheet, though this was later corrected, most probably by Linnaeus, to "5" (referring to *T. perfoliatum* in the first edition of *Species Plantarum*), and probably even later, an epithet "*alpestre*" was added. Indeed, the unnamed variety "β" of *T. perfoliatum* from the first edition of *Species Plantarum* (Linnaeus, 1753: 646) was renamed, according to the cited phrase-names, *T. alpestre* L. in the second edition of this work (Linnaeus, 1763: 903). This name is a later homonym of *T. alpestre* Jacquin (Jacquin, 1762: 116, 259–260). In addition the specimen bears the inscription "HU [Horto Upsaleinsi]" below the plant, indicating that the plant was cultivated in the Botanic Garden in Uppsala, and includes comments concerning the morphology of fruits by J. E. Smith, "semina utrinq. plana—incani 3 vel 4 / videtur *montanum* Huds." The plant on the sheet undoubtedly belongs to the *T. caerulescens* group and not to *T. montanum* in its present sense. Pertinent characters include: basal leaves are not abruptly attenuate; stem leaves have obtusely acute auriculae (rounded in *T. montanum*); petals are less than 3 mm long; siliquae are not fully developed, but they are narrowly obovate, widened at the tip, with acute wings (vs. widely obovate with rounded wings in *T. montanum*).

The second specimen (LINN 825.10) bears the inscription "8 montanum" in Linnaeus's hand on the bottom of the sheet, with a note by J. E. Smith, "semina utrinque 2 / 1 ex . . . [illegible] / Jacq. Austr. V. 3 t. 237," referring to Jacquin's illustration of *T. montanum* (Jacquin, 1775: 22, tab. 237), and an inscription in Linnaeus's hand, "Thlaspidium alb. Rupp. Thlaspi mont. album siliqua hastata, acuto globulariae folio Barr. ic. 897," on the reverse of the sheet. The plant on the sheet corresponds well to the present concept of *T. montanum*. It has abruptly narrowed basal leaves, stem leaves are oblong-ovate, flowering stems are not branched, flowers are large, sepals are 2–3 mm long, petals are 5–7 mm long and longer than anthers, and flowers are arranged in a semiglobular inflorescence. The plant was collected before the fruits had become fully developed. This plant, according to our opinion, will best serve as the lectotype and is here designated as such.

Acknowledgments. We thank Steve Cafferty and Charlie Jarvis of the Linnean Plant Name Typification Project for assistance, advice, and for the photo of Bauhin's figure; Gina Douglas, Librarian of the Linnean Society of London, for invaluable

help with the literature; and Grant Agency VEGA, Bratislava (Grant no. 7081), for financial support.

Literature Cited

Bauhin, C. 1623. Pinax theatri botanici, 1st ed. Basel.

Bauhin, J., J. H. Cherler & D. Chabrey. 1651. Historia Plantarum Universalis, Vol. 2. Ebroduni.

Clapham, A. R. & J. R. Akeroyd. 1993. Thlaspi. *In* T. G. Tutin, N. A. Burges, A. O. Chater, J. R. Edmondson, V. H. Heywood, D. M. Moore, D. H. Valentine, S. M. Walters & D. A. Webb (editors), Flora Europaea, 2nd ed. 2: 384–388. Cambridge Univ. Press, Cambridge.

Clusius, C. 1601. Rariorum Plantarum Historia. Antwerpen.

Columna, F. 1606. Minus Cognitarum . . . Stirpium. Romae.

Jacquin, N. J. 1762. Enumeratio Stirpium Plerarumque, Quae Sponte Crescent in Agro Vindobonensi. Vindobonae.

———. 1775. Florae Austriaceae, Vol. 3. Viennae.

Jalas, J., J. Suominen & R. Lampinen. 1996. Atlas florae Europaeae, Vol. 11. Helsinki.

Linnaeus, C. 1753. Species Plantarum, 1st ed. Holmiae.

———. 1763. Species Plantarum, 2nd ed. Vol. 2. Holmiae.

Morison, R. 1680. Plantarum Historiae Universalis Oxoniensis, Vol. 2. Oxonii.

Royen, A. van. 1740. Florae Leydensis Prodromus. Lugduni Batavorum.

Sauvages, F. B. de. 1751. Methodus Foliorum seu Plantae Florae Monspeliensis. 'S Gravenhage.

Dos Nuevas Combinaciones en *Corynabutilon* (Malvaceae) para Chile

Alicia Marticorena
Departamento de Botánica, Universidad de Concepción, Casilla 160-C, Concepción, Chile.
amartic@udec.cl

Resumen. Se proponen dos nuevas combinaciones para el género *Corynabutilon* desde *Abutilon*; *Corynabutilon hirsutum* (Philippi) A. Marticorena y *Corynabutilon viride* (Philippi) A. Marticorena. Se incluyen descripciones completas de ambas especies debido a que sólo se tienen las originales, y una clave dicotómica para la separación de las siete especies.

Abstract. Two new combinations in the genus *Corynabutilon* from *Abutilon*, *Corynabutilon hirsutum* (Philippi) A. Marticorena and *Corynabutilon viride* (Philippi) A. Marticorena, are proposed. Full descriptions are included for both species, because only the original descriptions are available. A dichotomous key for recognizing the seven species is included.

Key words: *Abutilon*, Chile, *Corynabutilon*, Malvaceae.

Schumann (1891) estableció *Corynabutilon* como sección de *Abutilon*, la que se caracteriza por presentar estigmas bilateralmente decurrentes. En ella incluyó *Abutilon bicolor* Philippi ex K. Schumann, *A. ceratocarpum* (Hooker & Arnott) Gay, *A. ochsenii* Philippi y *A. vitifolium* (Cavanilles) K. Presl. Philippi (1893) describe *Abutilon viride* Philippi de un material proveniente de Talcaregüe, cordillera de San Fernando, VI Región. Baker (1893) acepta la sección *Corynabutilon* con las especies mencionadas por Schumann (1891) e incluye *Abutilon viride*. Philippi (1858) describe ?*Anoda* [sic] *hirsuta* Philippi, desde la zona de Chillán, Chile. Reiche (1895) incluye *Abutilon viride* y combina *A. hirsutum* (Philippi) Reiche. Reiche (1896) describe *Abutilon salicifolium*, en cuya descripción señala los extremos de los estilos oblicuamente engrosados. Ulbrich (1932) menciona *Abutilon viride* Philippi, para la zona de Valdivia, Melefquén, Chile. Kearney (1949) eleva al rango de género la sección *Corynabutilon* y presenta cuatro nuevas combinaciones: *C. vitifolium* (Cavanilles) Kearney, *C. ceratocarpum* (Hooker & Arnott) Kearney, *C. ochsenii* (Philippi) Kearney y *C. bicolor* (Philippi ex K. Schumann) Kearney. Sin embargo, quedan dos especies sin nombre; *Abutilon hirsutum* (Philippi) Reiche y *A. viride* Philippi. Krapovickas (1969) combina *Corynabutilon salicifolium* (Reiche) Krapovickas. Fryxell (1997) señala cuatro especies para *Corynabutilon*, las que seguramente son las mismas de Kearney (1949).

El material tipo revisado posee estigmas bilateralmente decurrentes, caracter que lo separa del género *Abutilon* y lo incluye en *Corynabutilon*. Aunque no se han encontrado más caracteres que delimiten y separen a *Corynabutilon* de *Abutilon*, la morfología del estigma es un carácter estable y consistente en las especies estudiadas. Es importante mencionar además que las especies del género *Corynabutilon* presentan una distribución restringida en áreas templadas de Chile (30°40′–42°32′S), con sólo una especie, *C. bicolor*, también en Argentina. Esta característica refuerza la separación de estos taxa en un género distinto. Con los antecedentes mencionados se presentan dos nuevas combinaciones para el género *Corynabutilon*.

Corynabutilon (K. Schumann) Kearney, Leafl. W. Bot. 5. 189. 1949. *Abutilon* sect. *Corynabutilon* K. Schumann, in Martius, Fl. Bras. 12(3): 369. 1891. TIPO: *Sida vitifolia* Cavanilles [= *Corynabutilon vitifolium* (Cavanilles) Kearney].

Arbustos grandes y medianos, hojas elípticas, ovadas, oblongas, palmadas a subpinnadas, lobadas; flores solitarias o subcorimbosas, axilares, involucelo ausente, cáliz campanulado, lóbulos enteros, corola de el doble del cáliz, blanca a púrpura, ramas del estilo más o menos aplastadas, clavadas, estigmas bilateralmente decurrentes, fruto esquizocárpico endurecido, mericarpos apicalmente aristados.

Este género presenta afinidad con *Neobaclea* Hochreutiner, ya que ambos poseen el mismo tipo de estigmas, pero se diferencia en que posee los lóbulos del cáliz disectos, carácter único de este género.

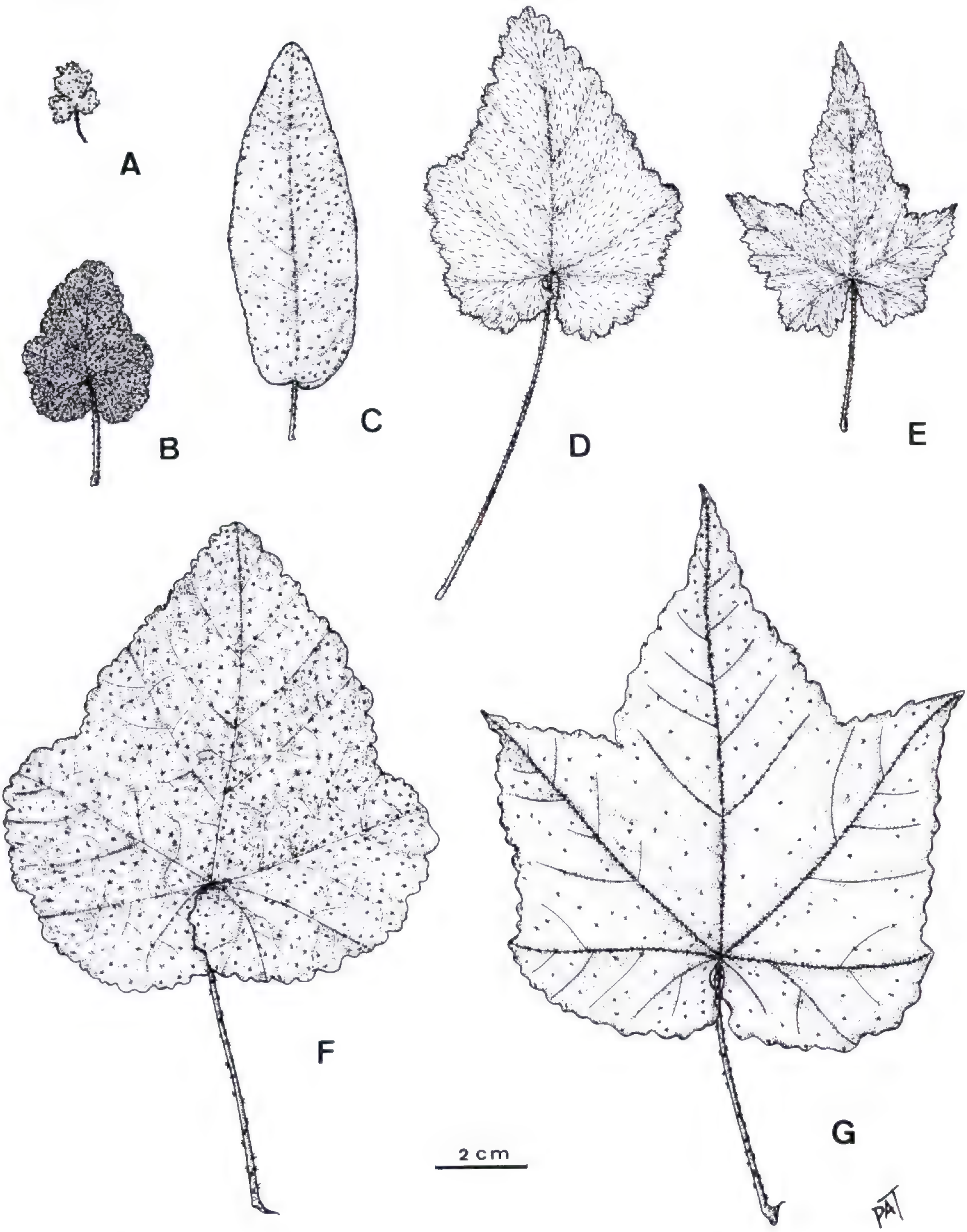


Figura 1. Hojas de las especies de *Corynabutilon*. —A. *C. bicolor*. —B. *C. ceratocarpum*. —C. *C. salicifolium*. —D. *C. hirsutum*. —E. *C. ochsenii*. —F. *C. viride*. —G. *C. vitifolium*.

Corynabutilon hirsutum (Philippi) A. Marticorena, comb. nov. Basiónimo: *Anoda hirsuta* Philippi, Linnaea 28: 675. 1858. *Abutilon hirsutum* (Philippi) Reiche, Anales Univ. Chile 91: 367. 1895, non K. Schumann, 1891. TIPO: Chile. VIII Región, Ñuble: "In Andibus de-part. *Chillan* legit. orn. Germain" (holótipo, SGO 51963).

Arbusto con tallos cubiertos de pelos simples, tiesos, finos. Hojas oblongo-ovadas, papiráceas, de 8.7–12 × 6.8–10 cm, acorazonadas, lóbulos poco

notorios, margen irregularmente crenado, hojas jóvenes con margen aserrado, ápice obtuso, cara superior cubierta de tricomas simples, tiesos, con algunos tricomas estrellados, cara inferior con tricomas estrellados solamente; pecíolo de 7.6–9.2 cm de largo, cubierto con la misma pubescencia; estípulas subtriangulares, de ca. 2.5 mm de largo. Pedúnculo bifloro, de hasta 14.2 cm de largo, pedúnculos individuales de 1.5–3.5 cm de largo. Cáliz de 13–21 mm de largo, con 5 dientes lanceolados, ápice agudo, cubiertos de tricomas tiesos, simples. Pétalos 5, de 2.2–2.6 cm de largo, apiculados asimétricamente, de color púrpura. Estilo clavado, estigmas bilateralmente decurrentes. Fruto compuesto por 7 mericarpos, de 8–9 mm de largo, cubiertos de tricomas tiesos simples, con arista de 2–2.5 mm de largo, algo recurvada.

Se diferencia de *C. viride* en la pubescencia con tricomas simples, tiesos, el largo y forma del cáliz, y en el largo de los pétalos.

Especímenes representativos. CHILE. **VIII Región, Los Angeles:** Precordillera de Mulchén. 37°42′S, 72°14′W, 22 feb. 1936, *Junge s.n.* (CONC 1296). **IX Región, Malleco:** Pailahueque, 38°07′S, 72°19′W, 360 m, ene. 1928, *Jaffuel y Pirión 968* (CONC 108518); Camino Quilquilco–Tolhuaca, 25 km E de Quilquilco, 38°14′S, 72°01′W, 15 dic. 1953, *Sparre y Smith 175* (CONC 17538); Victoria, Fundo Ontario, 38°28′S, 72°04′W, 450 m, 13 dic. 1957, *Montero 5417* (CONC 99266).

Corynabutilon viride (Philippi) A. Marticorena, comb. nov. Basiónimo: *Abutilon viride* Philippi, Anales Univ. Chile 82: 323. 1893. TIPO: Chile. VI Región, Colchagua: "Habitat in Andibus de *Talcaregue* dictis.", 34°39′S, 70°52′W, año 1870, *Philippi s.n.* (holótipo, SGO 51969).

Arbusto con tallos cubiertos de pelos estrellados, glaucos. Hojas ovadas, suborbiculares, papiráceas, de 6–10.6 × 5–9.7 cm, acorazonadas, lóbulos poco notorios, margen irregularmente crenado, ápice obtuso, ambas caras cubiertas de tricomas estrellados; pecíolo de 5–10 cm de largo, cubierto con la misma pubescencia; estípulas subtriangulares, de 3–4 mm de largo. Pedúnculo bifloro, de 6.1–7.6 cm de largo, pedúnculos individuales de 1.6–2.8 cm de largo. Cáliz de 8–10 mm de largo, con 5 dientes cortos, subtriangulares, de base ancha, ápice subagudo, cubiertos de tricomas estrellados. Pétalos 5, de 1.5–2 cm de largo, de color púrpura. Estilo clavado, estigmas bilateralmente decurrentes. Fruto compuesto por 5 mericarpos, de 14 mm de largo, cubiertos de tricomas tiesos simples, con arista de 5–5.5 mm de largo, más o menos recta, glabrescentes.

Esta especie es similar a *C. hirsutum* en la forma de la hoja, pero se diferencia de ella por presentar tricomas estrellados, cáliz con dientes triangulares, de base ancha, y pétalos de tamaño menor.

Especímenes representativos. CHILE. **VI Región, Colchagua:** Las Peñas, Cerro Chueco, 34°47′S, 70°51′W, 1800 m, 4 ene. 1955, *R. Barrientos 1684* (CONC 112823); Cordillera de San Fernando, año 1866, *F. Philippi 2121* (SGO 41035). **VII Región, Talca:** Alto de Vilches, camino a Laguna El Alto, 35°36′S, 71°01′W, 1800 m, 29 ene. 2000, *Finot y López 1713* (CONC 146688); Alto de Vilches, camino a Laguna El Alto, 35°36′S, 71°00′W, 2000 m, 29 ene. 2000, *Finot y López 1762* (CONC 146689). **VIII Región, Ñuble:** Atacalco, Chillán, faldas del Cerro Castillo, 36°53′S, 71°37′W, 1050 m, 30 nov. 1944, *Pfister s.n.* (CONC 6600).

Clave para Distinguir las Especies de *Corynabutilon*

1a. Hojas elípticas, no lobuladas . . . . . *C. salicifolium* (Fig. 1C)
1b. Hojas ovadas, oblongas, tripartida o 3–5-lobuladas.
  2a. Hojas de 5–13 mm de largo; lámina tripartida . . . . . *C. bicolor* (Fig. 1A)
  2b. Hojas mayores de 20 mm de largo; lámina 3–5-lobulada.
    3a. Lóbulos notorios, triangulares, el central alargado, ápice agudo, margen irregularmente dentado.
      4a. Hojas de 10–14 cm de largo, cara superior con tricomas estrellados; pétalos de 4–4.5 cm de largo . . . . . *C. vitifolium* (Fig. 1G)
      4b. Hojas de 3.6–7.5 cm de largo, cara superior con tricomas simples; pétalos de 2–3 cm de largo . . . . . *C. ochsenii* (Fig. 1E)
    3b. Lóbulos poco notorios, redondeados, el central no alargado, ápice obtuso, margen irregularmente crenado.
      5a. Hojas de 2–6 cm de largo, crasas, seríceas, tomentosas en el envés . . . . . *C. ceratocarpum* (Fig. 1B)
      5b. Hojas de 8.7–12 cm de largo, papiráceas, pubescentes en ambas caras.
        6a. Cara superior con tricomas simples, tiesos, en pecíolos, ramas y hojas; cáliz de 13–21 mm de largo, dientes lanceolados, angostos, agudos; pétalos de 2.2–2.6 mm de largo . . . . . *C. hirsutum* (Fig. 1D)
        6b. Cara superior con tricomas estrellados, en pecíolo, ramas y hojas; cáliz de 8–10 mm de largo, dientes subtriangulares, anchos, subagudos; pétalos de 1.5–2 mm de largo . . . . . *C. viride* (Fig. 1F)

Agradecimientos. Deseo agradecer al Proyecto Flora de Chile a través del cual he realizado este trabajo, a Pedro Arias por las ilustraciones, a la directora del herbario del Museo Nacional de His-

toria Natural de Santiago, Mélica Muñoz, por el préstamo de material tipo. En especial agradezco a Victoria Hollowell, editor científico de MBG Press, por sus comentarios y sugerencias, al igual que a dos revisores anónimos, quienes mejoraron sustancialmente este trabajo.

Literatura Citada

Baker, E. G. 1893. Supplement to Synopsis of Malveae. J. Bot. 31: 335–336.

Fryxell, P. 1997. The American genera of Malvaceae—II. Brittonia 49: 204–269.

Kearney, T. H. 1949. Malvaceae: A new subtribe and genus, and new combinations. Leafl. W. Bot. 5: 189–191.

Krapovickas, A. 1969. Notas citotaxonomicas sobre Malvaceas. Bonplandia (Corrientes) 3(2): 9–24.

Philippi, R. A. 1858. Plantarum novarum chilensium. Centuria altera. Linnaea 28: 661–704.

———. 1893. Plantas nuevas chilenas de la familia de las Malváceas. Anales Univ. Chile 82: 305–325.

Reiche, C. 1895. Estudios críticos sobre la flora de Chile. Malvaceas. Anales Univ. Chile 91: 361–413.

———. 1896. Estudios criticos sobre la flora de Chile. Anales Univ. Chile 94: 619–644.

Schumann, K. 1891. Malvaceae I. *In* Martius et al., Fl. Bras. 12(3): 253–456.

Ulbrich, E. 1932. Malvaceae americanae, imprimis andinae novae vel rariores. Notizbl. Bot. Gart. Berlin-Dahlem 11: 515–550.

Memecylon tirunelvelicum, a New Species of Melastomataceae from Peninsular India

C. Murugan, V. S. Manickam, and V. Sundaresan

Centre for Biodiversity and Biotechnology, Department of Botany, St. Xavier's College, Palayamkottai–627 002, Tamil Nadu, India

ABSTRACT. The new species *Memecylon tirunelvelicum* (Melastomataceae), collected from the Tirunelveli Hills of Tamil Nadu in Peninsular India, is described and illustrated. It is distinguished by the nerves on its leaves, a long and quadrangular peduncle, larger flowers with deeper calyx lobing but faint disc ray, and dense papillae on the ovary. It is closely related to *Memecylon grande* Retzius by its leaf shape and texture, terete branchlets, inflorescence position, and ovary shape.

Key words: India, Melastomataceae, *Memecylon*, Tamil Nadu, Tirunelveli Hills.

Memecylon is a paleotropical genus comprised of about 200 to 300 species (Bremer, 1987). Fifteen species are endemic to India, including the new species described here. Recent botanical explorations (1996–1999) to the Tirunelveli Hills at the southernmost end of the Western Ghats in the state of Tamil Nadu, India, yielded a taxon quite different from Indian species of *Memecylon* hitherto described. It is described here as a new species and is named after the type locality, namely Tirunelveli. This area is considered one of the biodiversity hot spots in India (Nayar, 1996).

Memecylon tirunelvelicum Murugan, Manickam & Sundaresan, sp. nov. TYPE: India. Tamil Nadu: Tirunelveli District, Kalakad Wild Life Sanctuary, Sengaltheri–Kulirati path, 900–1100 m, 27 Mar. 1998, *Manickam & Murugan 15299* (holotype, XCH; isotypes, MH, MO, XCH). Figure 1.

Haec species *M. grande* Retzius affinis, sed ab eo foliis parvis, pedunculo longo et quadrangulo (1.5–2.5 cm vice 1.0–1.5 cm), calyce profunde lobato, disci radiis indistinctis, ovario papillis densis ornato et ovulis paucioribus (6–9 vice 10–12) differt.

Shrub or *small tree*, to 4 m tall; branches and branchlets terete, glabrous, yellowish green when dry; bark thin, grayish brown, peeling off; internodes 3–9 cm long. *Leaves* opposite, elliptic to lanceolate, base cuneate or attenuate, apex acute to obtusely acuminate, 3.5–9 × 1.3–3.5 cm, margin entire, coriaceous, glossy, glabrous, yellowish green when dry; lateral nerves conspicuous; petiole 5–7 mm, canaliculate above, glabrous. *Inflorescence* axillary branched cymes, up to 4 cm long; peduncles quadrangular, 1.5–2.5 cm long; pedicels 5 mm long, terete, glabrous; bracts lanceolate, 2–4 mm long, persistent. Flowers 1 cm diam., regular, bisexual; 4-merous epigynous. *Calyx* tubes campanulate, 3 mm long, densely papillose; lobes 4, suborbicular, 1.5 × 3 mm, pink, papillose without, glabrous within, scarious along margin. *Petals* 4, blue, ovate, 5 × 5 mm, base slightly clawed, broad in middle, obtusely acute at apex. *Disc rays* inconspicuous. *Stamens* 8, subequal, incurved in bud; filaments subulate, to 2 mm; anthers falcate 3 mm long, 2-loculed; glands terminal on anther lobes, oblong, 1.25 × 0.5 mm. *Ovary* subglobose, inferior, 3 mm across, densely papillose without, unilocular; ovules ca. 6 to 9, free-central placentae; styles linear-subulate, 3–5 mm, glabrous; stigmas acute, yellow. *Berries* globose, 1.2 × 1 cm, yellow; seeds 1 cm, testa crustaceous.

Distribution. Endemic to the Tirunelveli Hills; recorded so far from only three localities, namely, Sengaltheri, between the Naraikadu and Vistharamalai path and Manjoli in Western Ghats, Tamil Nadu, India.

Phenology. Flowering in March; fruiting June–September.

Ecology. The new species is found in the semi-evergreen forests between 900 and 1100 m, and is associated with *Clausena austroindica* B. C. Stone & K. K. N. Nair, *Mallotus aureo-punctatus* Mueller Argoviensis, *Syzygium gardneri* Thwaites, *Eugenia rottleriana* Wight & Arnott, *Mallotus muricatus* Beddome, *Ellertonia rheedii* Wight, *Chomelia asiatica* Kuntze, *Peristophe montana* Nees, etc.

Etymology. The specific epithet refers to the type locality of this species.

Paratypes. INDIA. **Tamil Nadu:** Tirunelveli District, Naraikadu to Vistharamalai, 1000 m, 7 June 1998, *Man-*

Figure 1. *Memecylon tirunelvelicum* Murugan, Manickam & Sundaresan. —A. Fertile branch with axillary cymes. —B. Inflorescence bract. —C. Flower (upper view). —D. Petal. —E. Stamens. —F. Pistil with densely papillate calyx. —G. Calyx with pistil (upper view). —H. Ovary (longitudinal section). —I. Ovary (cross section) (XCH 15299). —J. Drupe (XCH 15997).

ickam & Murugan 15997 (XCH); Manjoli, 1100 m, 4 Sep. 1998, *Manickam & Murugan 17349* (XCH).

Memecylon tirunelvelicum is allied to *Memecylon grande* Retzius, but the new species differs by conspicuous nerves in the leaves, a long and quadrangular peduncle, large flowers with a deeply lobed calyx, a faint disc ray, and dense papillae on the ovary.

KEY TO THE SPECIES OF *MEMECYLON* IN THE TIRUNELVELI HILLS

1a. Leaves obtuse/cordate at base.
  2a. Inflorescence pedunculate cymes . . . . . *M. subramanii* Henry
  2b. Inflorescence fascicled cymes.
    3a. Branchlets quadrangular.
      4a. Petals not clawed; leaf base cordate . . . . . *M. wightianum* Triana
      4b. Petals clawed; leaf base obtuse . . . . . *M. subcordatum* Cogniaux
    3b. Branchlets terete.
      5a. Disc rays faint; calyx tube campanulate; leaves ovate . . . . . *M. malabaricum* (Clarke) Cogniaux
      5b. Disc rays prominent; calyx tube saucer-shaped; leaves lanceolate . . . . . *M. depressum* Bentham ex Triana
1b. Leaves acute/cuneate at base.
  6a. Branchlets quadrangular/subangulate.
    7a. Flowers sessile; calyx tube saucer-shaped . . . . . *M. lushingtonii* Gamble
    7b. Flowers pedicellate; calyx campanulate.
      8a. Peduncle > 3 mm long; 3-flowered umbel . . . . . *M. gracile* Beddome
      8b. Peduncle < 3 mm long; many-flowered umbel.
        9a. Leaves elliptic-lanceolate; petals clawed; calyx saucer-shaped . . . . . *M. angustifolium* Wight
        9b. Leaves elliptic-ovate; petals not clawed; calyx tube campanulate . . . . . *M. umbellatum* Burman f.
  6b. Branchlets terete.
    10a. Inflorescence terminal . . . . . *M. manickamii* Murugan, Sundaresan & Jothi
    10b. Inflorescence lateral/axillary.
      11a. Flowers sessile in fascicles/tubercles.
        12a. Leaves lanceolate; leaf nerves and disc rays prominent . . . . . *M. heyneanum* Bentham ex Wight & Arnott
        12b. Leaves ovate; leaf nerves and disc rays obscure . . . . . *M. flavescens* Gamble
      11b. Flowers pedicellate in branched cymes.
        13a. Calyx tube saucer-shaped; petals emarginate at apex; leaf veins < 6 pairs . . . . . *M. edule* Roxburgh
        13b. Calyx tube campanulate; petals acute at apex; leaf veins > 6 pairs.
          14a. Peduncles < 1.5 cm long; bracteoles oblong; ovary laxly papillose . . . . . *M. grande* Retzius
          14b. Peduncles > 1.5 cm long; bracteoles lanceolate; ovary densely papillose . . . . . *M. tirunelvelicum* Murugan, Manickam & Sundaresan

Acknowledgments. We express our sincere thanks to R. Gopalan, Scientist, Madras Herbarium (MH), Coimbatore and V. Chelladurai, Research officer, Survey of Medicinal Plants Unit, Palayamkottai, for excellent comments that improved the manuscript. We are grateful to the University Grants Commission (No. F.3-39/96) of India for financial support and the Field Director, Kalakad–Mundanthurai Tiger Reserve and Conservator of Forest Wild Life, Tirunelveli, for their cooperation during the field studies. We thank H. Sankar (Artist), Centre for Biodiversity and Biotechnology, St. Xavier's College, Palayamkotai–627 002, India, for preparing the illustrations.

Literature Cited

Bremer, K. 1987. Melastomataceae. Pp. 157–240 *in* M. D. Dassanayake & F. R. Fosberg (editors), A Revised Handbook to the Flora of Ceylon Vol. VI. Amerind Publishing, New Delhi.

Nayar, M. P. 1996. Endemic plants of Peninsular India. Pp. 1–62 *in* Hot Spot of Endemic Plants of India, Nepal and Bhutan. SB Press, Trivandrum–1.

Isoetes mattaponica (Isoetaceae), a New Diploid Quillwort from Freshwater Tidal Marshes of Virginia

Lytton John Musselman
Department of Biological Sciences, 302F Mills Godwin Building/45th Street, Old Dominion University, Norfolk, Virginia 23529-0266, U.S.A. lmusselm@odu.edu

W. Carl Taylor
Department of Botany, Milwaukee Public Museum, 800 West Wells Street, Milwaukee, Wisconsin 53233-1478, U.S.A. ct@mpm.edu

Rebecca D. Bray
Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266, U.S.A. rbray@odu.edu

ABSTRACT. *Isoetes mattaponica* is a rare quillwort of freshwater tidal rivers of eastern Virginia with a somatic chromosome number of $2n = 22$. Megaspores have low rugulate muri on both the proximal and distal surfaces; the girdle is broad. Microspores are echinate-spinose with ornamented spines. *Isoetes mattaponica* may be one of the parents of several polyploids in the Southeastern United States.

Key words: Isoetaceae, *Isoetes*, North America, quillwort, United States, Virginia.

Chesapeake Bay quillworts have been extensively studied (reviewed in Musselman & Knepper, 1997, and Caplen & Werth, 2000a) but largely extirpated due to pollution and urbanization. The following taxa are known from the southern parts of the Chesapeake Bay (Musselman & Knepper, 1997): *Isoetes engelmannii* A. Braun ($2n = 22$); *I. saccharata* Engelmann [$2n = 44$, including *I. hyemalis* Brunton ($2n = 44$)]; and *I. acadiensis* Kott ($2n = 44$). For a clear understanding of relationships among these polyploids, knowledge of the basic diploids is essential. A new diploid species from the freshwater tidal marshes of Virginia is described.

Isoetes mattaponica L. J. Musselman & W. C. Taylor, sp. nov. TYPE: U.S.A. Virginia: King William County, Mattaponi River, plants in *Pontederia cordata-Nuphar luteum* marsh, along a tidal shore of the Mattaponi River, ca. 0.75 km S of Aylett, 7 Aug. 1997, *W. C. Taylor 6052* (holotype, MIL). Figures 1–6.

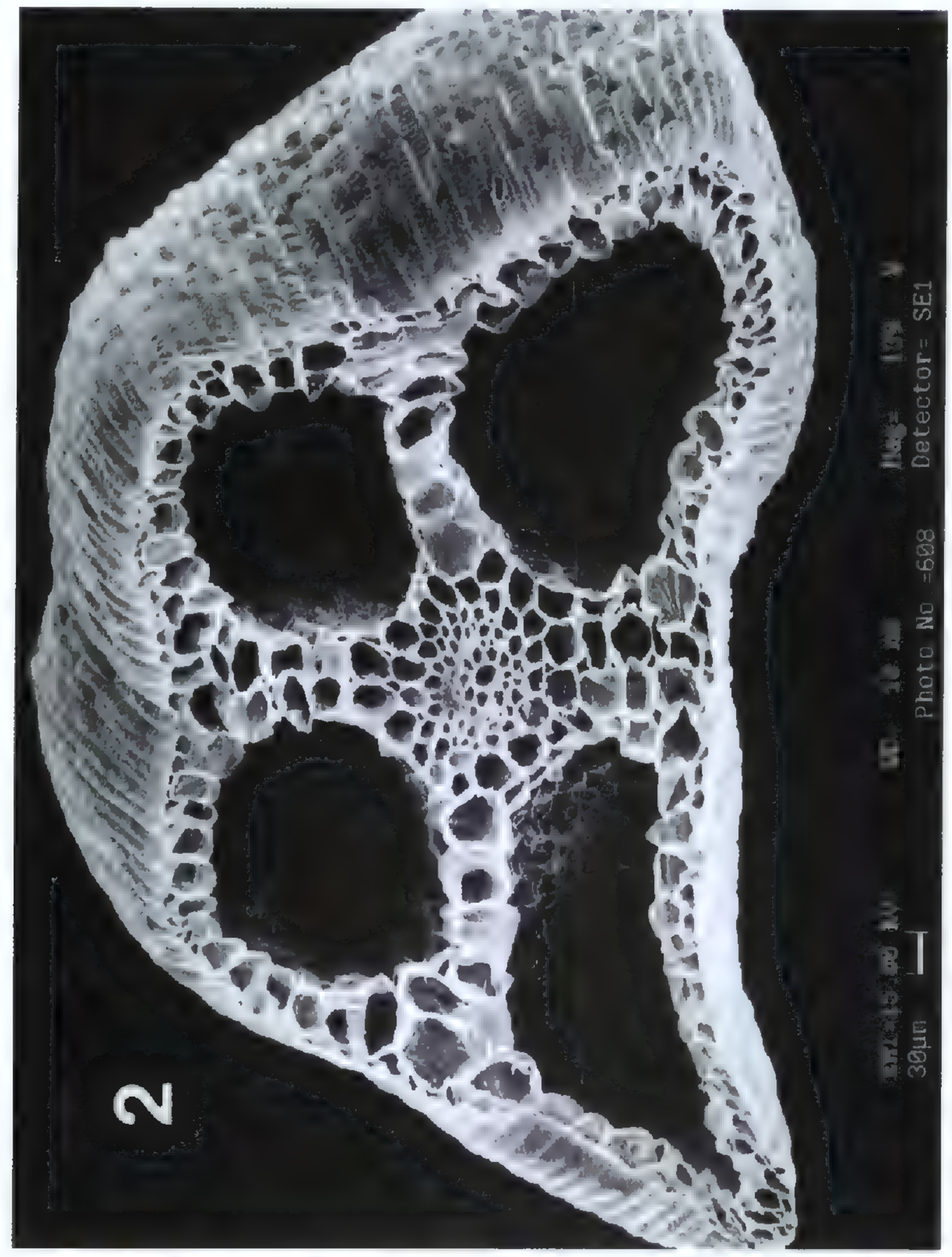
Planta aquatica, emergens, amphibia aestus zonam habitans; caudice subgloboso, bilobo. Folia vivide viridia, basin versus pallida, in spiram disposita, usque ad ca. 25 cm longa, ca. 1 mm lata ad medium longitudinis, flexibilia. Sporangium basale, obovatum ad late ellipticum, ca. 2.5–3.5 mm longum; pariete fasciculis sparsis linearibus ad oblongis cellularum brunnearum unius ad quattuor maculato, velo incompleto membranaceo pro parte 25–75% tecto; megasporis albis, 280–360 μm diametro ($x = 330$ μm), inconspicue verrucato-rugatis, cingulo lato; microsporae pallide canis in massa, 22–28 μm ($x = 25$ μm), echinatis. Chromosomatum numerus $2n = 22$.

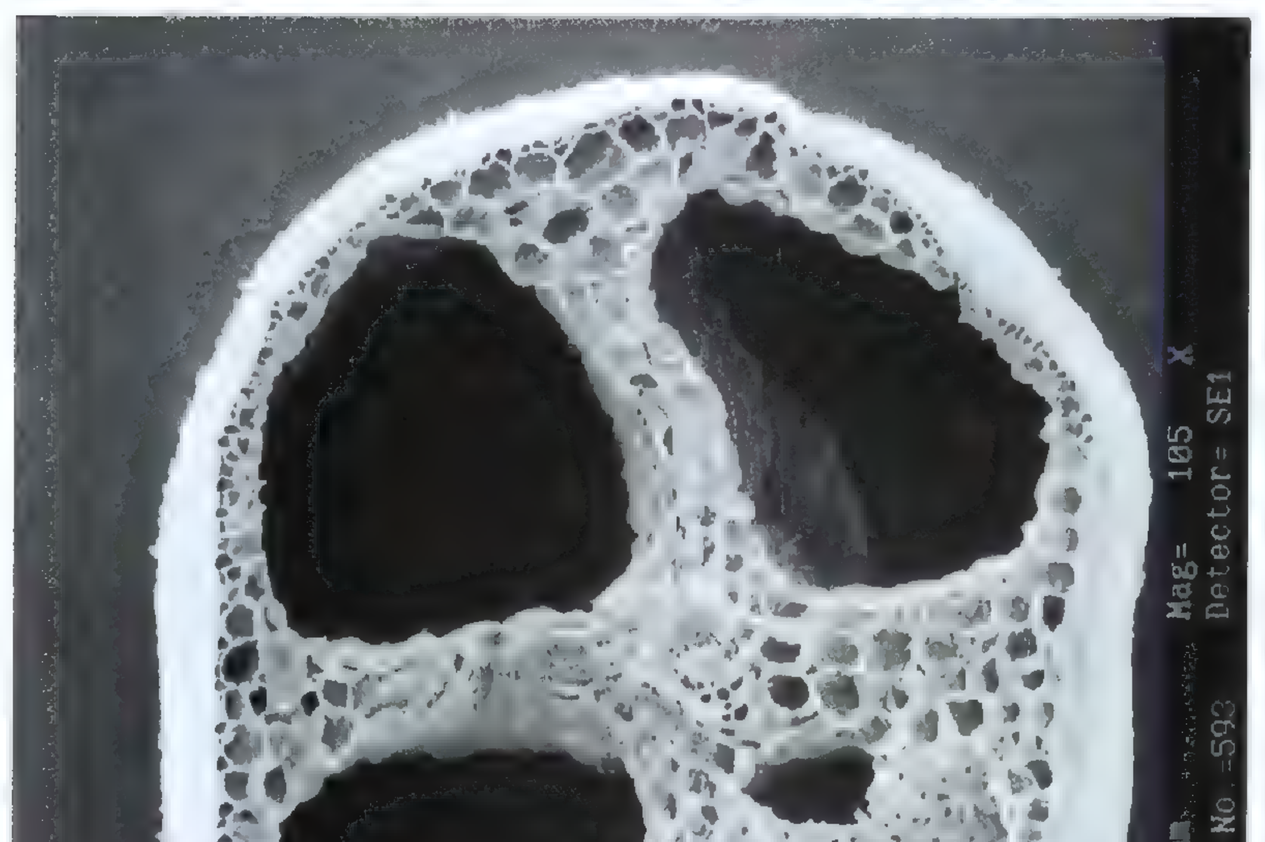
Plant aquatic, emergent, tidal-amphibian. Rootstock subglobose, bilobed. Leaves bright green, pale toward base, spirally arranged, ca. 25 cm long, ca. 1 mm wide at mid length, pliant. Labium absent. No peripheral strands present. Central intrastelar canal one. Velum incomplete, membranous, covering ± 25–75% of sporangium wall. Sporangia basal, obovate to widely elliptic, ca. 2.5–3.5 mm long, walls spotted with scattered, linear to oblong clusters of 1 to 4 brown-colored cells. Megaspores white, ca. 280–360 μm diam. ($x = 330$ μm), obscurely verrucate-rugate, girdle wide, ornamentation obscure. Microspores light gray in mass, ca. 22–28 μm long ($x = 25$ μm), echinate. Chromosomes: $2n = 22$.

Distribution. Chickahominy, Pamunkey, and Mattaponi Rivers of eastern Virginia.

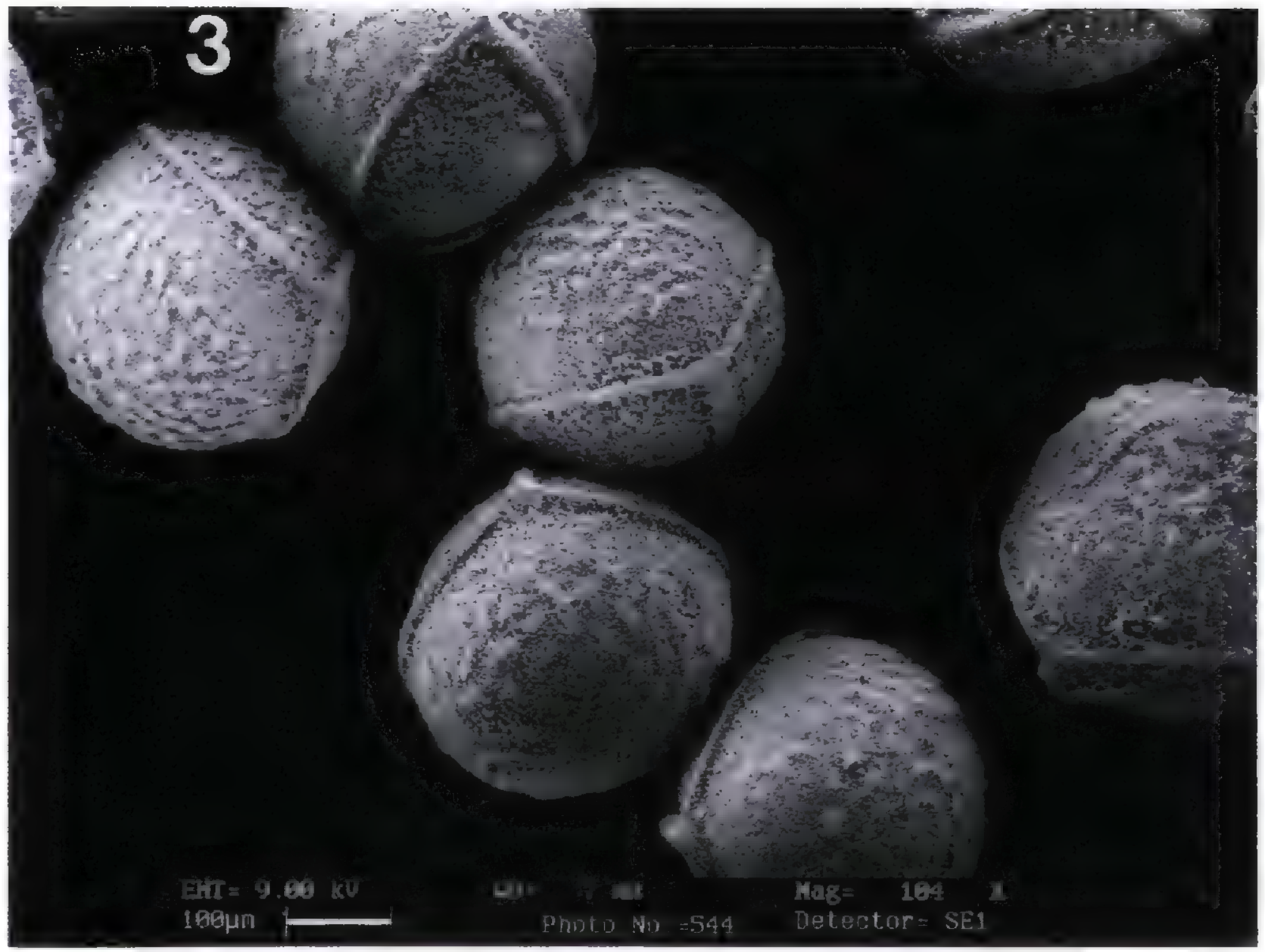
Mattaponi is the name of a tribe of Native Americans living along these coastal rivers.

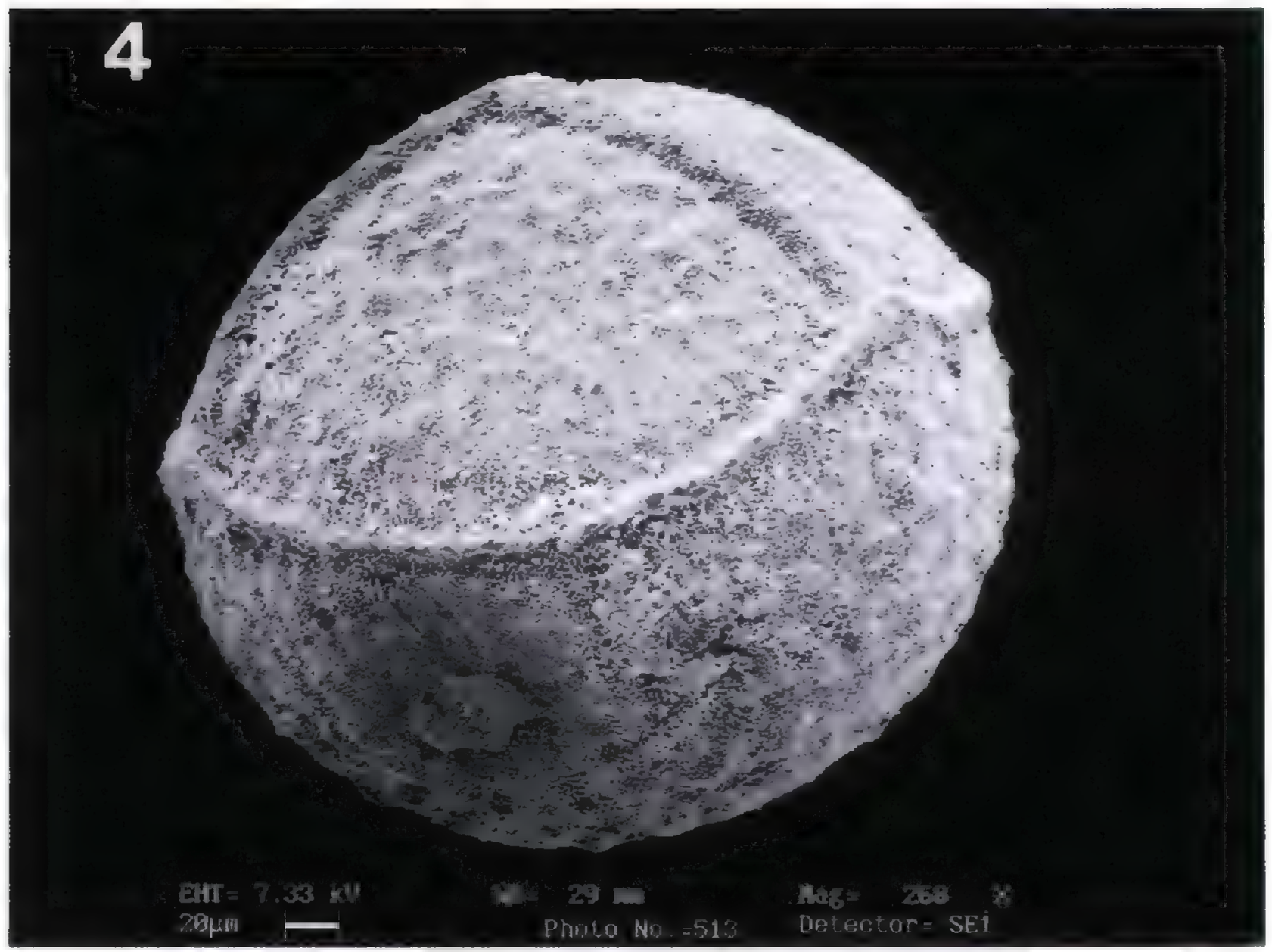
Paratypes. U.S.A. **Virginia:** King William County, Aylett, *Taylor 6052* (MIL), *Musselman 98902* (ODU), *Musselman 99176* (ODU); King and Queen County, 1.5 km S of Aylett, *Musselman 99178* (ODU); New Kent County, 3.0 km N of Pamunkey Indian Reservation, *Musselman 96042* (ODU); Charles City County, 4.5 km S of Walker Dam, *M. Pease s.n.* (ODU); Wilcox Neck, *Musselman 99186* (mixed collection) (ODU).





Figures 1, 2. Leaf cross sections (*Musselman 99178*). —1. Midsection of *I. mattaponica* leaf. No peripheral strands are evident. Note diaphragm with characteristic stellate cells in lower left lacuna. Scale (lower left) 100 μm. —2. Lower portion of leaf with single intrastelar canal. Scale (lower left) 30 μm.





Figures 3, 4. Megaspores of *I. mattaponica*.—3. Spore on upper left exhibits the wide girdle found in this species (*Musselman 99178*). Scale (lower left) 100 µm. —4. The ornamentation is similar on both the proximal and distal surfaces (*Taylor 6052*). Scale (lower left) 20 µm.

Figures 5, 6. Microspores of *I. mattaponica* (*Taylor 6052*). —5. General views of microspores showing echinate pattern. Scale (lower left) 1 μm. —6. Detail of processes at tip of spines. Scale (lower left) 3 μm.

Leaf features. The leaves of *Isoetes mattaponica* lack peripheral strands and have a single intrastelar canal (Figs. 1, 2). *Isoetes engelmannii, I. acadiensis,* and *I. hyemalis* also possess a single intrastelar canal (Bray, unpublished). More populations and taxa need to be examined to establish the taxonomic value of peripheral strands. Stomata are present on the leaves of *I. mattaponica.* Unlike most southeastern quillworts (Bray & Musselman, unpublished), *I. mattaponica* lacks scales.

Spore morphology and size. Isoetes acadiensis also grows in the tidal rivers of southeastern Virginia and superficially resembles *I. mattaponica.* Megaspore size and ornamentation differ between the two taxa, however. Spores of *I. mattaponica* are slightly smaller (x = 330 μm) than *I. acadiensis* (x = 412 μm). *Isoetes mattaponica* megaspores (Figs. 3, 4) have an obscure, low, rugulate sculpturing; those of *I. acadiensis* are boldly rugulate-reticulate. Lastly, the girdle of *I. mattaponica* is wider and less ornamented than that of *I. acadiensis.*

Megaspores of *I. mattaponica* superficially resemble those of the basic diploid *I. melanopoda* Gay & Durieu. However, the rugulate, low (< 5 μm), rounded muri of *I. mattaponica* megaspores differ from the tuberculate ornamentation of *I. melanopoda* (Taylor et al., 1993). They more closely resemble the muri of *I. acadiensis,* a tetraploid that grows with *I. mattaponica.*

Microspores of *I. mattaponica* are strongly echinate (Fig. 5) and have fringed processes at the tips of some spines (Fig. 6). Fringed processes occur on several North American species of *Isoetes* (Musselman, unpublished).

Megaspores mature from the middle of June to the middle of August. Microspores develop from the first of July to the end of August. By October, most sporophylls have decayed and only a few depauperate leaves, lacking sporangia, remain. Like other Chesapeake Bay submergent quillworts, *I. mattaponica* stays green during the winter.

Cytology. Isoetes mattaponica has a basic diploid chromosome number of 22. Only two diploid quillworts have been described from North America the past one hundred years—*I. tegetiformans* Rury and *I. prototypus* D. M. Britton (Taylor et al., 1993). Like *I. mattaponica,* these two diploids also have a very restricted range (Taylor et al., 1993).

Field characters. In common with most quillworts, there is little to distinguish *I. mattaponica* from other species. Its general appearance and chromosome number have similarities to *I. melanopoda* ($2n$ = 22), a wide-ranging, variable species of North America with shallowly ornamented megaspores (Taylor et al., 1993).

Molecular characters. Recently, Sarah Hoot (pers. comm.) has used the second intron of the leafy (*lfy*) in her phylogenetic studies of *Isoetes.* Her preliminary sequence data support *I. mattaponica* as a distinct species with about 15 unique substitutions and one indel not found in any other species of *Isoetes.*

In an allozyme study of the *I. riparia* complex—all tetraploids ($2n$ = 44)—Caplen and Werth (2000b) found *I. mattaponica* to be one of the most likely parents for ten different populations of "*I. riparia*" in the Southeast.

Ecology. The rivers in which this quillwort grows are unique freshwater tidal river systems of Chesapeake Bay. At their borders lie extensive and relatively undisturbed marshes. Federally endangered plants found here include *Aeschynomone virginica* (L.) Britton, Sterns & Poggenburg and *Hemianthus* (= *Micranthemum*) *micranthemoides* Nuttall. *Isoetes mattaponica* is part of a guild of isoetid plants (plants with rosette leaves, tufted roots, and often CAM photosynthesis). Isoetids in these marshes include *Eriocaulon parkeri* Robinson, *Lilaeopsis chinensis* (L.) Kuntze, and *Sagittaria subulata* (L.) Buchenau. Other species that grow with *I. mattaponica* are *Acorus calamus* L., *Elatine triandra* Schkuhr, *Eleocharis parvula* (Roemer & Schultes) Link, *Nuphar advena* (Aiton) Aiton f., *Orontium aquaticum* L., *Peltandra virginica* (L.) Schott & Endlicher, *Pontederia cordata* L., and *Zizania aquatica* L.

Isoetes mattaponica, like some of its cohorts, apparently is a rare plant. We have seen it at only five sites in four Virginia counties: Charles City, King and Queen, King William, and New Kent. No previous collections are known. Careful searches should be made, however, before populations are adversely affected by marsh disturbance through water withdrawal and urbanization.

Acknowledgments. We have benefited from discussions with C. Caplen, R. J. Hickey, K. Heafner, and D. Knepper. Doug Davis, Davis Environmental, helped locate populations. Plates were made by R. Jones. Michael Adam prepared the materials for electron microscopy. Research was supported, in part, by the Mary Payne Hogan Fund.

Literature Cited

Caplen, C. A. & C. R. Werth. 2000a. Isozymes of the *Isoetes riparia* complex, I. Genetic variation and relatedness of diploid species. Syst. Bot. 25: 235–259.

——— & ———. 2000b. Isozymes of the *Isoetes riparia* complex, II. Ancestry and relationships of polyploids. Syst. Bot. 25: 260–280.

Musselman, L. J. & D. A. Knepper. 1997. Chesapeake Bay quillworts. Wetland J. 9: 3–6.

Taylor, W. C., N. T. Luebke, D. M. Britton, R. J. Hickey & D. F. Brunton. 1993. Isoetaceae H. G. L. Reichenbach-Quillwort Family. Pp. 64–75 *in* Flora of North America Editorial Committee (editors), Flora of North America North of Mexico, Vol. 2. Oxford Univ. Press, New York.

The Taxonomy of the *Carex bicknellii* Group (Cyperaceae) and New Species for Central North America

Paul E. Rothrock
Randall Environmental Center, Taylor University, 236 W. Reade Avenue, Upland, Indiana 46989-1001, U.S.A.

A. A. Reznicek
University of Michigan Herbarium, North University Building, Ann Arbor, Michigan 48109-1057, U.S.A.

ABSTRACT. Based on morphology and karyology, we found the eastern North American species *Carex bicknellii* (sect. *Ovales)* to be a complex of four species. We describe two new species, *C. missouriensis* and *C. shinnersii,* and raise one variety, *C. bicknellii* var. *opaca,* to species rank as *C. opaca.* The three species segregated from *C. bicknellii* have lower chromosome numbers: $n = 23$ II + 1 III to 27 II for *C. missouriensis,* $n = 29$ II + 1 III to 30 II for *C. shinnersii,* and $n = 32$ II + 1 III to 34 II for *C. opaca.* All three species are characterized by large tussocks, herbaceous textured foliage and smooth sheaths, and long apiculum on the achenes; they occupy hydric habitats. *Carex missouriensis,* a species characterized by awned pistillate scales, grows in remnant prairie swales from western Indiana to southeastern Nebraska. *Carex opaca,* with blunt scales and large perigynia, has a narrow distribution mostly limited to the periphery of the Ozark Mountain system. *Carex shinnersii,* with acuminate but unawned scales and perigynia smaller than *C. opaca* and *C. missouriensis,* ranges from northern Texas to southern Kansas. This last species is also contrasted with *C. brevior,* a species with similar morphology and overlapping range. *Carex bicknellii* in the strict sense is morphologically similar to the northeastern species *C. merritt-fernaldii.* They both have few culms per tussock, coriaceous foliage with papillose sheaths, papery, erose-margined perigynia, achenes with a very short apiculum, and relatively high chromosome numbers ($n = 35$ II to 39 II). These two species differ in characters of the anther, achene, and perigynium. They occupy more or less xeric habitats, especially in the Central Plains of the United States (*C. bicknellii*) and southern Canada eastward from the Great Lakes region (*C. merritt-fernaldii*).

Key words: *Carex,* Cyperaceae, North America.

In North America, *Carex* L. sect. *Ovales* Knuth is a complex and diverse group of sedges with approximately 45 species occurring east of the Rocky Mountains. Recent studies of *Carex* biogeography (e.g., Hyatt, 1998) reveal that this section has still not received the attention necessary in the central United States, with some species proving much more common and extensive in range than previously understood. Even more importantly, taxonomic studies have brought to light new species of surprisingly common occurrence in the Ozark Mountain region and adjacent plains such as *C. ozarkana* P. Rothrock & Reznicek (1996a) and *C. molestiformis* Reznicek & P. Rothrock (1997).

Carex bicknellii Britton (sensu lato) is frequent in the prairie flora of the central United States (Mackenzie, 1931). As is typical for members of section *Ovales,* taxa within the *C. bicknellii* group have caespitose growth habit, gynecandrous spikes, more or less flattened, winged perigynia, and lenticular achenes with two stigmas.

The systematics of plants allied with *Carex bicknellii* has always been one of the most difficult problems within *Carex* sect. *Ovales.* Mackenzie (1931) provided the most recent monographic treatment of section *Ovales,* and he placed *C. bicknellii* in his large "subsection" *Festucaceae.* Members of the *Festucaceae* are characterized by sterile culms bearing erect or ascending leaves clustered at the shoot apex, perigynia with non-obovate bodies, and leaf sheaths having a strong white-hyaline zone on the ventral surface. In Mackenzie's treatment, *C. bicknellii* is placed close to *C. merritt-fernaldii* Mackenzie, *C. brittoniana* L. H. Bailey [= *C. tetrastachya* Scheele], and *C. hyalina* F. Boott. Since Mackenzie's monograph of the genus, Hermann (1972) described *C. bicknellii* var. *opaca* F. J. Hermann as a puzzling variation with affinities to *C. merritt-fernaldii* and *C. brittoniana.* This group has been informally designated the "*C. brevior* group"

by Reznicek and Rothrock (1997) and includes *C. brevior* (Dewey) Mackenzie, *C. molesta* Mackenzie ex Bright, *C. festucacea* Willdenow, *C. molestiformis* Reznicek & P. E. Rothrock, as well as *C. merritt-fernaldii*, *C. bicknellii*, *C. bicknellii* var. *opaca*, and *C. tetrastachya*.

Variation in perigynium size in this group is especially striking, and is arrayed along a geographical spectrum. The widespread eastern species *C. festucacea* and the very widespread more northern and transcontinental *C. brevior* have the smallest perigynia of the group (2.3–5 × 1.5–3.5 mm), whereas the southwestern-most species, *C. tetrastachya*, has the largest (5.5–8(–8.7) × (3.5–)4–6.1 mm). Lying between these two extremes, both geographically and in perigynium size, are plants referred to as *C. bicknellii*. In most keys, *C. bicknellii* is sharply delimited by its large perigynia that are strongly nerved over the achene on the adaxial surface.

As understood at the beginning of our investigation, *Carex bicknellii* consisted of two varieties. The typical variety has translucent copper-tinged perigynia and few culms per clump. It occurs not only in dry to mesic prairie of the central United States, but also has populations scattered eastward to Pennsylvania and New England. The rarer *C. bicknellii* var. *opaca*, as its name implies, has less translucent (but still thin and papery) perigynia that lack any copper coloration. Although found in historically prairie habitat, this taxon, compared to typical *C. bicknellii*, occupies more hydric sites and has a narrower geographic range that includes Arkansas, parts of Missouri, and eastern Kansas.

Our initial research questions focused upon sharpening our understanding of the taxonomy and biogeography of *Carex bicknellii* var. *opaca* and upon how, morphologically and ecologically, to differentiate *C. bicknellii* from *C. merritt-fernaldii*. It soon became apparent from our field investigation and chromosome studies that the species limits and probable relationships for *C. bicknellii* were poorly understood. *Carex bicknellii* (sensu stricto) should be recognized as an entity distinct at the species level from *C. bicknellii* var. *opaca* based on morphological and karyological criteria. In turn, the latter proved to be a complex of three species: *C. opaca*, *C. missouriensis*, and *C. shinnersii*, the last two described later in this paper. Once these additional species elements are clarified, *C. bicknellii* (sensu stricto) and *C. merritt-fernaldii* form a coherent group with only a more distant phylogenetic relationship to *C. opaca* and its related species.

Materials and Methods

This study was based upon available materials from the following herbaria: APCR, BH, BRIT, BUT, Hb. C. T. Bryson (personal herbarium of Charles T. Bryson, Stoneville, Mississippi), DAO, DUKE, F, GA, GH, ILLS, IND, ISC, KANU, KSC, MICH, MO, MOR, MT, NCU, NDA, NEB, NHA, NY, OKL, OMA, OS, PUL, SIU, TRTE, UNB, US, WIN, and WIS. Approximately 3000 sheets were studied.

Morphological variation within the *Carex bicknellii* complex was assessed by analysis of herbarium specimens selected from the geographic, habitat, and morphologic ranges of these taxa. After a broad survey of all the morphological and micromorphological characters that appeared to vary among these species, we quickly focused on qualitative and quantitative features of the achenes, perigynia, pistillate scales, inflorescences, and sheaths as offering the best discriminating potential. In addition to the herbarium material examined, we undertook extensive fieldwork for chromosome and morphological studies in an area extending from western Indiana to southern Iowa and southward to northern Texas. Less extensive field studies were carried out in New England and the Great Lakes region. A total of about 70 populations were examined in the field.

Numerical analyses, including univariate statistics and scatter plots, focused upon characters of the perigynium, pistillate scale, and achene. With the exception of papillose versus non-papillose epidermal surface, diagnostic vegetative characters could not be found. Principal component analysis (PCA) aided in exploring differences between *C. missouriensis*, *C. opaca*, and *C. shinnersii*. The PCA was based upon a sample of 110 specimens and 16 quantitative traits. A somewhat smaller sample size for *C. shinnersii* (N = 33) reflects the rarity of this taxon. From standardized data, NTSYS-pc (version 2.0, Rohlf, 1997) was used to obtain a correlation matrix, extract Eigenvectors, and plot OTUs.

Chromosome analyses followed the technique of Cooperrider and Morrison (1967) as detailed in Rothrock and Reznicek (1996b). Briefly, overwintered plants were stimulated to flower under greenhouse conditions. Immature spikes were collected and preserved in methanol, chloroform, and propionic acid (6:3:2). Anthers were dissected from the spikes and squashed in 2% lactic-acetic-orcein and viewed using phase contrast at 1000× magnification. Meiosis I chromosome figures were examined from five or more pollen mother cells. Drawings, photographs, and voucher herbarium specimens

Table 1. Chromosome counts for members of the *Carex bicknellii* group. Vouchers cited are deposited in MICH, with photographs. AAR = A. A. Reznicek, PER = P. E. Rothrock.

Species	*n*	Source
Carex bicknellii Britton	38 II	Löve & Löve (1981)
	38 II	IL, Macoupin Co., *PER 3547a*
	38 II	IL, Macoupin Co., *PER 3547b*
	38 II	MO, Callaway Co., *PER 3554*
	39 II	MO, Audrain Co., *PER 3549*
Carex merritt-fernaldii Mackenzie	35 II	Tanaka (1942)
	37 II	Tanaka (1942)
	37 II	Rothrock & Reznicek (1998)
	37 II	OH, Lucas Co., *PER 3732*
Carex opaca P. Rothrock & Reznicek	32 II +1 III	AR, Lonoke Co., *PER 2886*
	32 II +1 III	MO, Stoddard Co., *PER 3551c*
	33 II	Rothrock & Reznicek (1996b)
	33 II	OK, Ottawa Co., *AAR 9761*
	34 II	MO, Stoddard Co., *PER 3551a*
	34 II	MO, Stoddard Co., *PER 3551b*
Carex shinnersii P. Rothrock & Reznicek	29 II +1 III	TX, Delta Co., *AAR 10367b*
	30 II	TX, Delta Co., *AAR 10367a, c*
	30 II	TX, Kaufman Co., *AAR 10347*
Carex missouriensis P. Rothrock & Reznicek	23 II +1 III	MO, Macon Co., *PER 3567*
	24 II +1 III	IL, Fayette Co., *PER 3539a*
	24 II +1 III	IL, Fayette Co., *PER 3539b*
	24 II +1 III	MO, Chariton Co., *PER 3560*
	24 II +2 III	IL, Clinton Co., *PER 3569*
	25 II	MO, Audrain Co., *PER 3550*
	25 II +1 III	MO, Macon Co., *AAR 9856*
	26 II	MO, Callaway Co., *PER 3553*
	26 II	MO, Schuyler Co., *PER 3557*
	27 II	IL, Macoupin Co., *PER 3546*

cited in Table 1 have been deposited at the University of Michigan Herbarium (MICH).

Results

Carex bicknellii and *C. merritt-fernaldii* share habitat, vegetative, reproductive, and karyotypic characters that separate them sharply from *C. opaca, C. missouriensis,* and *C. shinnersii. Carex bicknellii* and *C. merritt-fernaldii* occupy drier habitats (upland prairies; dry open, sandy woodlands and savannas; sandy or gravelly, dry successional habitats; and thin, dry soil over rock) and, under both field and greenhouse conditions, have fewer shoots per tussock. The leaf sheaths of these two species, except on the ventral hyaline band, bear fine papillae visible at 30× magnification (Fig. 1). The contrasting species (*C. missouriensis, C. opaca,* and *C. shinnersii*), found in wet prairies, ditches, and open bottomlands, often in clay or muck soils, not only may produce many culms per tussock but have sheaths that are consistently devoid of papillae.

Reproductive characters also indicate a close affinity between *C. bicknellii* and *C. merritt-fernaldii.* The perigynium wall of these two species is thin-textured or even more or less translucent and tends to form an erose, scalloped, or even irregularly toothed margin at the shoulder. This is in contrast to the thicker-textured, opaque perigynium wall with uniformly fine-serrulate, usually symmetrically tapered margins typical of species in section *Ovales* as a whole. Furthermore, the achenes of *C. bicknellii* and *C. merritt-fernaldii* contrast with those of *C. opaca, C. missouriensis,* and *C. shinnersii.* The latter group of species bears a prominent apiculum, 0.4–1.2 mm long (mean = 0.74 ± 0.02, N = 108), but apicula of *C. bicknellii* and *C. merritt-fernaldii* seldom reach 0.5 mm (mean = 0.28 ± 0.01, N = 63) (Figs. 2, 3).

Finally, karyological investigation supports the close affinity of *Carex bicknellii* and *C. merritt-fernaldii* (Table 1). We found a haploid number of *n* = 38 II or 39 II (5 counts) for *C. bicknellii.* Chromosome counts for *C. merritt-fernaldii* range from 35 II as reported by Tanaka (1942) to 37 II (Rothrock & Reznicek, 1998) (4 counts). These contrast markedly to the very low chromosome counts ob-

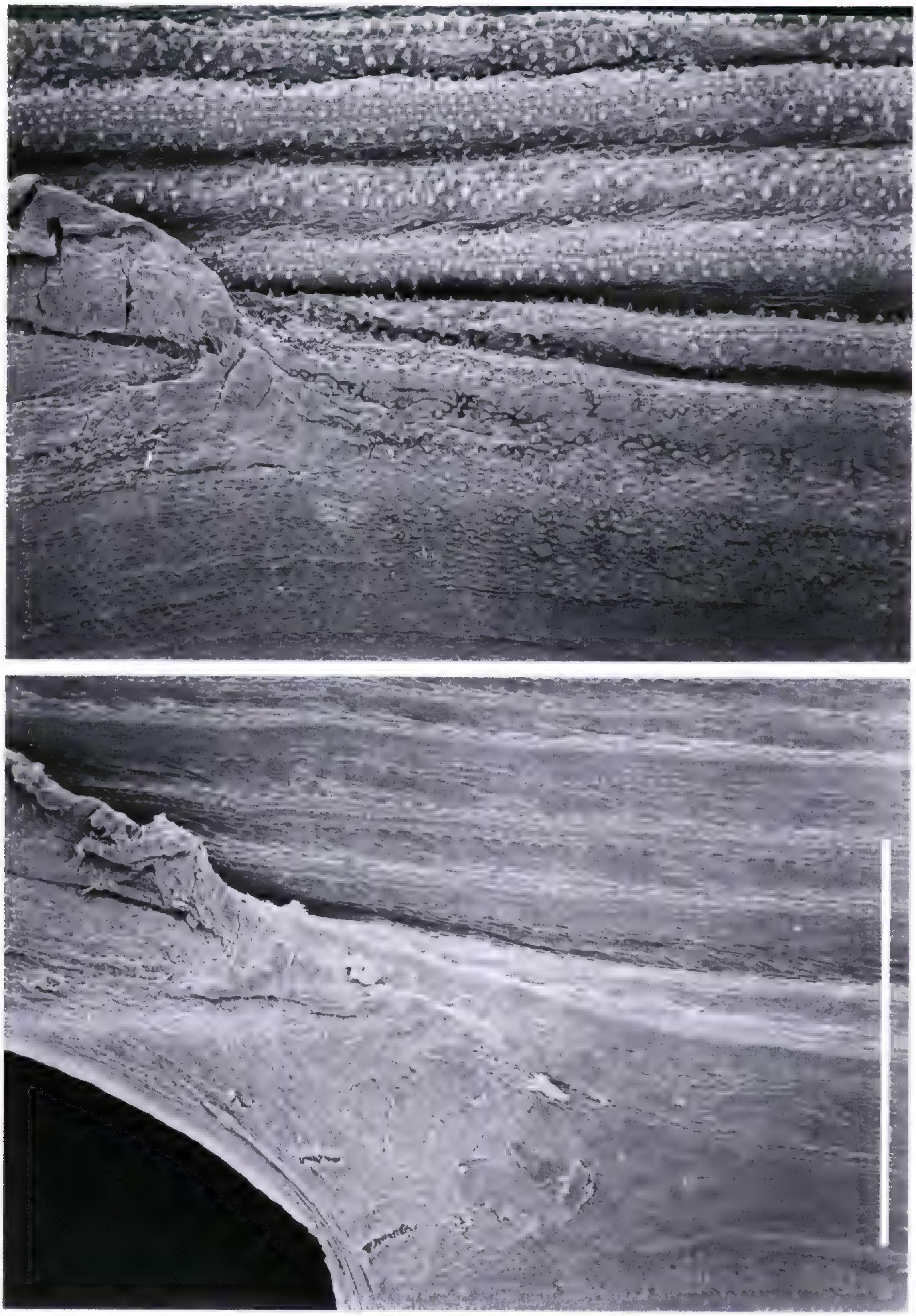


Figure 1. Scanning electron micrograph of leaf sheaths: *Carex bicknellii* (right) and *C. missouriensis* (left). Scale bar = 1 mm for both species.

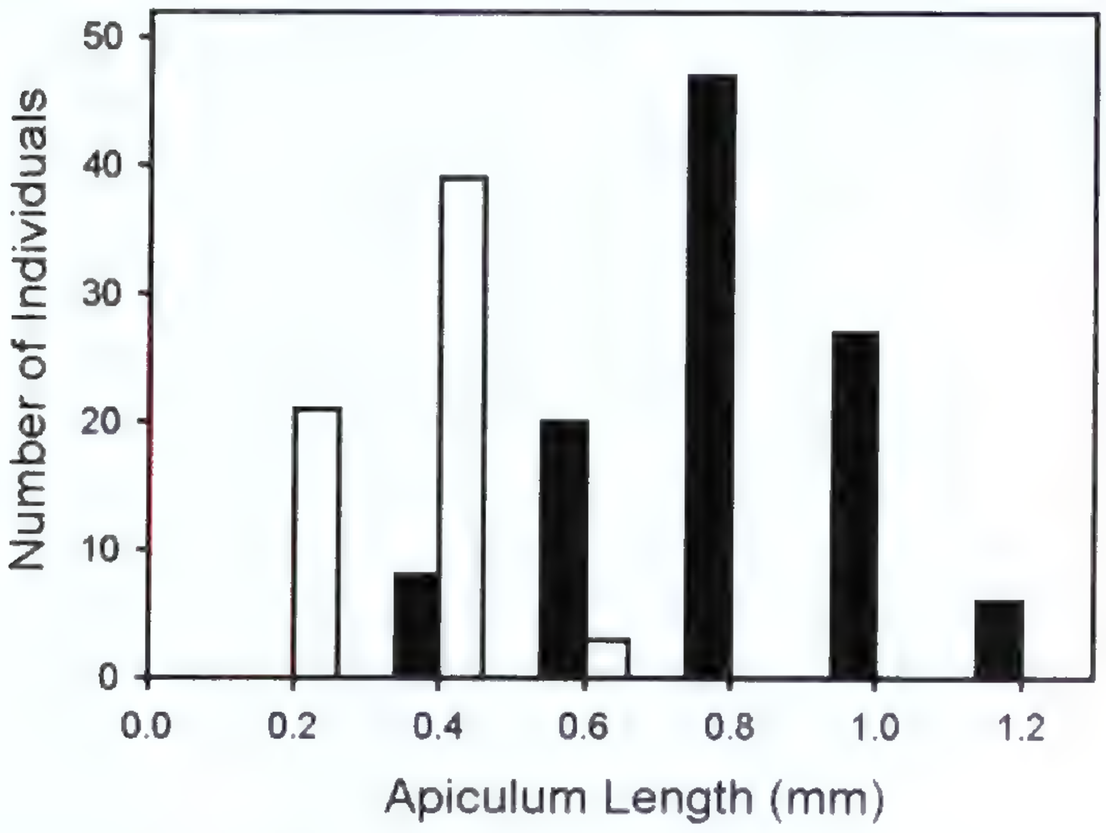


Figure 2. Apiculum length of *Carex bicknellii* and *C. merritt-fernaldii* (open bars) versus that of *C. missouriensis*, *C. opaca*, and *C. shinnersii* (solid bars).

served for *C. missouriensis* (n = 23 II + 1 III to 27 II; 10 counts) and slightly higher counts for *C. opaca* (n = 32 II + 1 III to 34 II; 6 counts) and *C. shinnersii* (n = 29 II + I III and 30 II; 3 counts) (Table 1).

Carex merritt-fernaldii has sometimes been submerged into a broadly conceived *C. brevior*, but still with the recognition of *C. bicknellii* (Gleason, 1952; Gleason & Cronquist, 1991). This represents a misunderstanding of the relationships within this group. *Carex brevior* differs in numerous vegetative, reproductive, and karyotypic features from *C. merritt-fernaldii*, and they are certainly not each other's closest relatives. In fact, many of the features by which *C. missouriensis*, *C. opaca*, and *C. shinnersii* differ from *C. bicknellii* and *C. merritt-fernaldii* are also the features by which *C. brevior* differs from *C. bicknellii* and *C. merritt-fernaldii*, including lower chromosome number (Rothrock & Reznicek, 1998), smooth sheaths, uniformly fine-serrulate, symmetrically tapered perigynium margins, and thicker-textured, opaque perigynia. It seems quite likely that a phylogenetic study of section *Ovales* would show that *C. missouriensis*, *C. opaca*, and *C. shinnersii* are more closely related to *C. brevior* and its close allies than to *C. bicknellii* and *C. merritt-fernaldii*. We use the term *Carex bicknellii* group only because all three of these species previously have been considered part of *C. bicknellii*.

TAXONOMY OF *CAREX MISSOURIENSIS*, *C. OPACA*, AND *C. SHINNERSII*

Initially, our realization that *Carex opaca* included additional taxa grew out of an investigation of

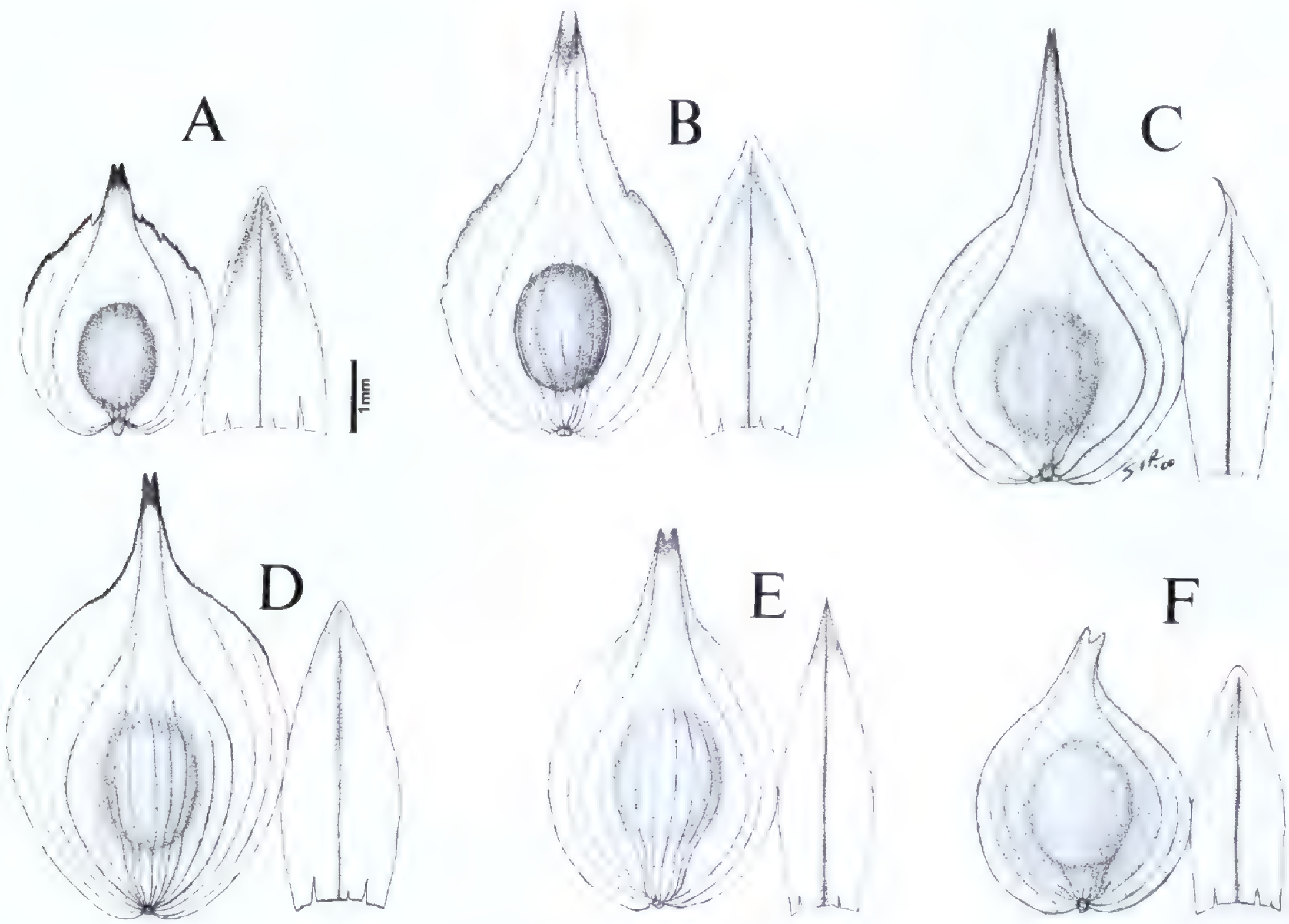


Figure 3. Perigynia and pistillate scales of: —A. *Carex merritt-fernaldii* (from *Reznicek 10067*), —B. *C. bicknellii* (from *Reznicek 10203*), —C. *C. missouriensis* (from *Reznicek 9859*), —D. *C. opaca* (from *Sheperd 340*), —E. *C. shinnersii* (from *Morse 3450*), and —F. *C. brevior* (from *Morse 3451*). Vouchers at MICH.

Table 2. *Carex missouriensis*, *C. opaca*, and *C. shinnersii* Eigenvector weightings in Axis 1 and Axis 2 for 16 characters of pistillate scale, perigynium, and achene. Variation in Axis 1 = 34.0%; variation in Axis 2 = 15.7%.

Character	Axis 1	Axis 2
Pistillate scale length (mm)	0.208	0.424
Pistillate scale width (mm)	0.613	−0.005
Pistillate scale length:width ratio	−0.502	0.301
Perigynium length (mm)	0.877	−0.092
Perigynium width (mm)	0.784	0.201
Perigynium body length (mm)	0.898	0.089
Distance from base to widest point of perigynium (mm)	0.536	0.478
Distance to widest point:body length ratio	−0.536	0.487
Beak length (mm)	0.230	−0.378
Achene summit to beak apex (mm)	0.692	−0.510
Beak length:distance to beak apex ratio	−0.632	0.228
Number of adaxial nerves	0.427	0.567
Achene length (mm)	0.126	0.633
Achene width (mm)	0.482	0.662
Achene length:width ratio	−0.381	−0.152
Apiculum length (mm)	0.705	−0.279

meiotic karyotypes. A population from Macon County, Missouri, from prairie swale habitat, was found to possess a strikingly low number of chromosomes. Further analysis of *C. missouriensis* confirmed that this condition was consistent (Table 1) and could be associated with readily observable macroscopic traits. In contrast to *C. opaca* (with haploid chromosome numbers of n = 32 II + 1 III, 33 II, 34 II), *C. missouriensis* chromosome numbers range from n = 23 II + 1 III to 27 II (Table1).

During the morphometric analysis of inflorescence, perigynium, and achene characters of *Carex opaca* and *C. missouriensis*, a third taxon became evident. This species, *C. shinnersii*, includes populations from Texas originally reported by Jones and Reznicek (1991) as *C. bicknellii* var. *bicknellii*. With n = 29 II + 1 III or 30 II chromosomes, the karyotype of *C. shinnersii* is intermediate in number between *C. opaca* and *C. missouriensis* (Table 1).

Although karyologically distinctive, the morphological differences between these species can be subtle. We have not discovered vegetative characters that are diagnostic among the three species. Instead, the potential diagnostic characters are limited to the spikes, especially qualitative traits of the pistillate and staminate scales. Of the three species, *Carex opaca* has scale apices that are obtuse to acute (Fig. 3), similar to most species within section *Ovales*. Pistillate scales of *C. missouriensis*, on the other hand, are clearly awn-tipped (up to 0.7 mm long), with the awns often somewhat curly and often slightly recurved. The awns and recurved tendency are most evident at the pre-flowering stage of spike development when the spike takes on a decidedly echinate appearance. The awns in *C. missouriensis* are quite distinctive in being whitish-hyaline tissue that appears to be an extension of the relatively broad hyaline scale margins and lacks a midvein. Several apparently unrelated species within section *Ovales* also have awn-tipped scales (e.g., *C. alata* Torrey, *C. hormathodes* Fernald, and *C. straminea* Willdenow). None of these species possesses the slight recurvation or echinate immature spikes, and the awns appear to be the excurrent midveins of the scales. The presence of the awn tip in these species likely represents a homoplasy. The scale apex in *C. shinnersii*, the third member of this complex, is acuminate and occasionally appears to be awned (Fig. 3). However, unlike *C. missouriensis*, the tip is firm and colored because it is formed by the excurrent midvein extending beyond the herbaceous scale tip.

The PCA of 16 quantitative traits of the pistillate scale, perigynium, and achene (Table 2) documented the fine differences between these species. *Carex opaca* forms a cluster that is high on both axis 1 and axis 2. However, it has some degree of overlap with *C. missouriensis* and *C. shinnersii*. The Eigenvector values (Table 2) suggest that the position of *C. opaca* primarily is due to its somewhat larger perigynia (particularly overall length, width, and body length). *Carex missouriensis* clustered low on axis 2. The Eigenvector values, in this case, suggest that *C. missouriensis* has smaller achenes and a more elongated beak area (as measured by the distance from the achene summit to beak apex). *Carex shinnersii*, which occupies the quadrate low on axis 1 and high in axis 2 (Fig. 4), has the small-

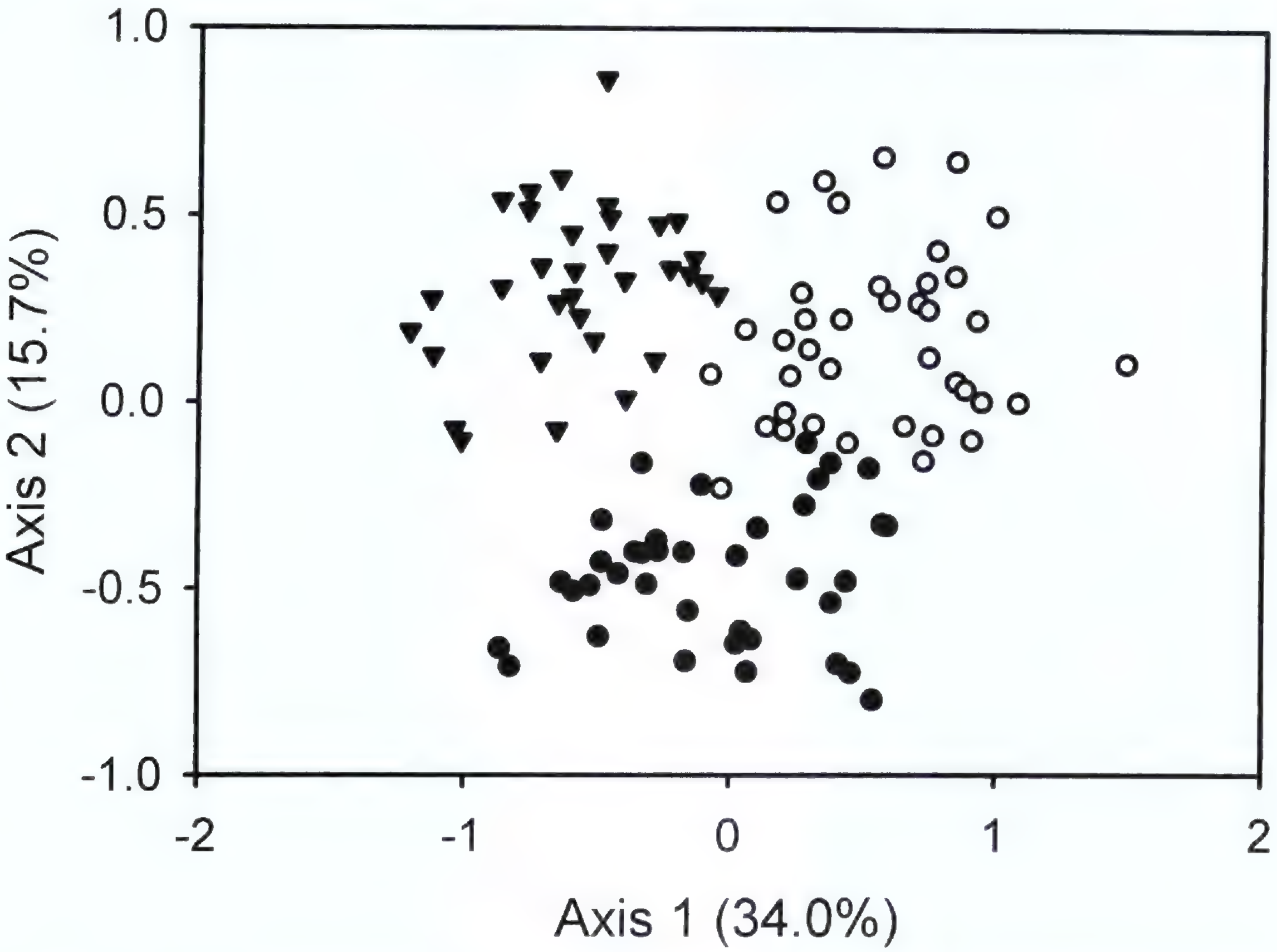


Figure 4. PCA of *Carex missouriensis* (dots), *C. opaca* (circles), and *C. shinnersii* (inverted triangles) showing axis 1 and axis 2.

est perigynia. For example, perigynium length averages 5.2 ± 0.1 (N = 33) compared to 5.7 ± 0.1 (N = 39) and 6 ± 0.1 (N = 38) for *C. missouriensis* and *C. opaca*. Much of the differential between *C. shinnersii* and *C. missouriensis* perigynia is localized in the upper body and beak. The achene summit to beak apex distance for *C. shinnersii* seldom reaches 3 mm, but the same length measure in *C. missouriensis* is mostly 3–3.8 mm.

The apices of pistillate and staminate scales are diagnostic among the three species, and we therefore carefully explored other possible quantitative differences in the pistillate scales. PCA provided only moderate Eigenvector values for overall width and length to width ratio of pistillate scales (Table 2) and small values for overall length. However, differences in these characters exist among the species. Pistillate scales of *Carex shinnersii* are narrower (1.32 ± 0.13 mm; N = 33) compared to those of *C. opaca* (1.53 ± 0.18 mm; N = 38). The average pistillate scale length to width ratio of *C. shinnersii* is 3.26 ± 0.38 in contrast to 2.86 ± 0.23 (N = 39) for *C. missouriensis* and 2.76 ± 0.27 for *C. opaca*. Unfortunately, due to strongly overlapping ranges, these differences, although meaningful, are difficult to apply to individual plants.

Aside from members of the *Carex opaca* complex, the sedge species most difficult to distinguish from *C. shinnersii* is *C. brevior*. *Carex brevior*, as we currently understand this species, has broad morphological as well as karyotypic variation. Plants from populations in Texas, Oklahoma, Wisconsin, and Manitoba can be remarkably robust. We evaluated the variation of pistillate scale, perigynia, and achenes in a sample of *C. brevior* that included available robust specimens as well as "typical" *C. brevior*. In evaluating the pistillate scale, we attempted a careful quantification of the amount of pointedness to the pistillate scale. This value is the distance from the scale apex to where scale width reaches 0.5 mm. Although a very few exceptional *C. brevior* individuals had perigynia barely over 5 mm in length, they could, with few exceptions, be separated from *C. shinnersii* when combined with pistillate scale length (Fig. 5). Even sharper differences between taxa were achieved by contrasting perigynium length with scale pointedness (Fig. 6). The latter feature, though quite difficult to measure,

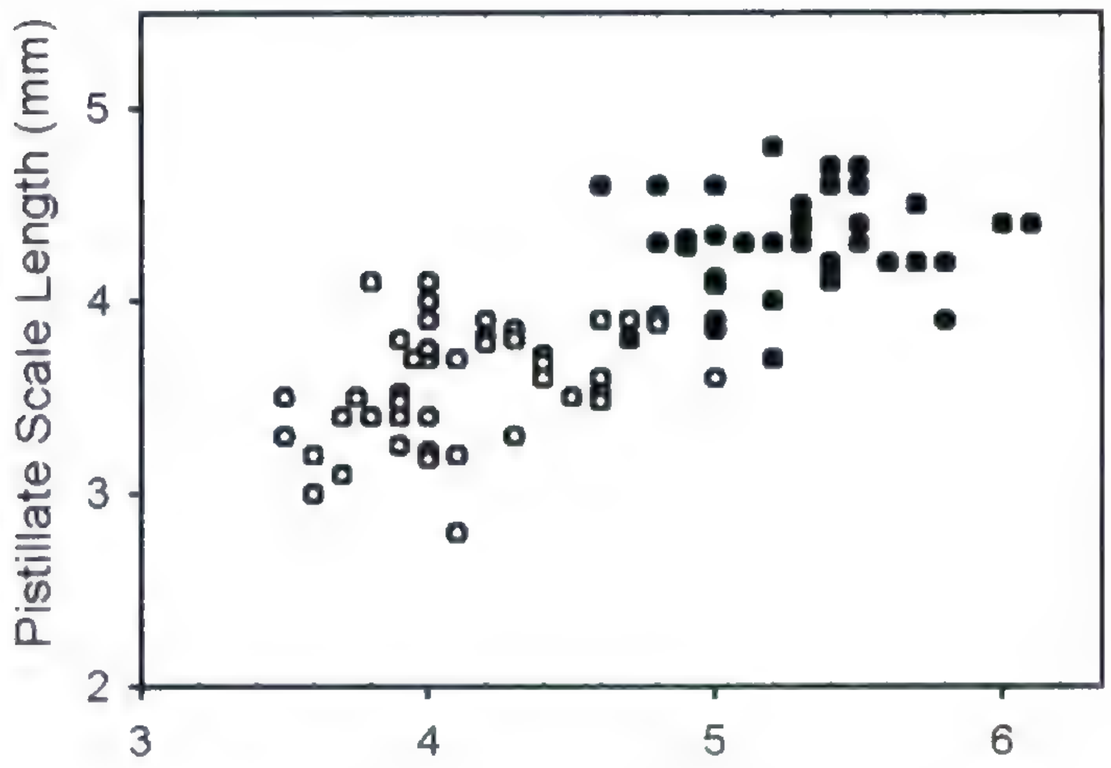


Figure 5. Scatter plot of perigynium length and pistillate scale length of *Carex brevior* (circles) and *C. shinnersii* (dots).

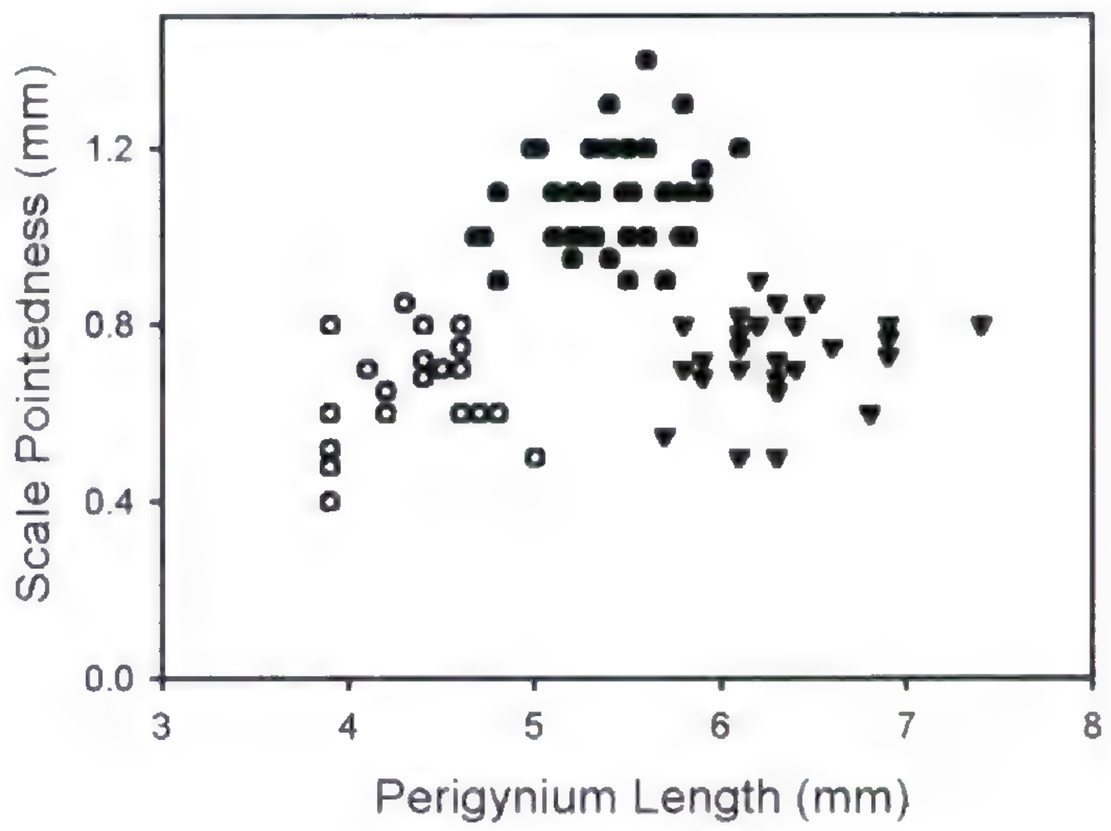


Figure 6. Scatter plot of perigynium length and pistillate scale pointedness of *Carex brevior* (circles), *C. opaca* (inverted triangles), and *C. shinnersii* (dots). Pointedness is the distance from the scale apex to where scale width equals 0.5 mm.

also proved valuable when confronted with poor-quality specimens of *C. shinnersii* and *C. opaca* in regions of geographical sympatry.

The following key distinguishes the species treated here from all the other members of the *Carex brevior* group. This includes all eastern North American members of Mackenzie's (1931) "subsection" *Festucaceae* with very broadly elliptic to orbicular or even reniform perigynium bodies, these mostly also more than 2 mm wide. Eleven species are included here, out of a total of about 45 eastern North American species in section *Ovales*.

KEY TO THE *CAREX BREVIOR* GROUP INCLUDING *C. BICKNELLII* AND THE RELATED *C. OPACA* COMPLEX

1a. Plants colonial from short-creeping rhizomes; vegetative culms numerous and conspicuous, strongly tristichous and with 15 to 35 leaves when fully developed; achenes 1.6–2 times as long as wide (and 0.9–1.2 mm wide); larger spikes with 5 to 25(30) perigynia . . . . . *C. hyalina*

1b. Plants definitely clumping (though rhizomes may appear elongate in old clumps); vegetative culms few, inconspicuous, and usually with fewer than 15(17) leaves, thus not strikingly tristichous; achenes 1–1.6(–1.7) times as long as wide (and 0.9–2.2 mm wide); larger spikes with 15 to 80 perigynia.

2a. Perigynia finely granular-papillose (30–40×), the body reniform, 0.6–0.9 times as long as wide (and 3.2–4.9 mm wide); lower pistillate scales obtuse-rounded . . . . . *C. reniformis*

2b. Perigynia smooth, the body broadly ovate, elliptic, ± orbicular, or rarely slightly obovate, (0.7–)0.9–1.7 times as long as wide (and 1.5–6.1 mm wide); lower pistillate scales obtuse to acuminate-awned.

3a. Larger perigynia 2.5–5.5 mm long, 1.5–3.6 mm wide, with beaks usually 0.7–1.6(–1.8) mm long; perigynia often plumply planoconvex or concavo-convex, the bulge formed by the achene prominent only on the abaxial face.

4a. Leaf sheaths finely papillose at high magnification (30–40×); perigynia membranaceous, the brown achene clearly visible through the translucent adaxial face of the perigynium at maturity; usually at least some perigynia with the wings and base of beak irregularly erose, scalloped, or even with irregular teeth and often not symmetric.

5a. Perigynia strongly and evenly 4- to 8-nerved over the achene on the adaxial face, (4.5–)5.1–5.5 mm long, wings usually strongly reddish brown tinged; pistillate scales usually reddish brown, usually (1–)1.4–2.3 mm shorter than the perigynia; anthers (2.4–)2.8–4.2 mm long . . . . . *C. bicknellii*

5b. Perigynia nerveless or faintly and irregularly 0- to 5(6)-nerved over the achene on the adaxial face, (2.3–)2.5–5.2(–5.5) mm long, wings yellowish tinged or greenish, pistillate scales yellowish tinged or greenish, 0.2–1.3 mm shorter than the perigynia; anthers (1–)1.3–2.6 mm long.

6a. Perigynia 2.5–3.4 mm wide; distance from summit of achene to tip of beak 1.8–3.1 mm; achenes 1.3–1.5 mm wide . . . . . *C. merritt-fernaldii*

6b. Perigynia 1.5–2.4(–2.6) mm wide; distance from summit of achene to tip of beak 0.8–1.7(–2) mm; achenes (0.95–)1–1.3 mm wide . . . . . *C. festucacea*

4b. Leaf sheaths smooth; perigynia herbaceous, opaque, achene not clearly visible through the adaxial face of the perigynium, with the wings and base of beak usually finely and uniformly ciliate and ± symmetric.

7a. Spikes on larger culms (3)5 to 7(11), tapered at the base, the terminal one with a

conspicuous staminate base; inflorescences typically open, 2.5–4.5(–6.5) cm long with the lowest internodes (3–)4–13(–23) mm long; perigynium body (0.7–)0.9–1.3 times as long as wide (rarely to 1.6 in *C. shinnersii*).

8a. Larger achenes 1–1.3 mm wide, 1.2–1.8 mm long; larger perigynia 2.5–4(–4.2) mm long, 1.5–2.4(–2.6) mm wide, mostly 2- to 4(6)-nerved adaxially . . . . . *C. festucacea*

8b. Larger achenes (1.2–)1.4–1.8 mm wide, (1.6–)1.7–2.2 mm long; larger perigynia 3.2–5.5 mm long, 2.5–3.6 mm wide, nerveless or faintly 1- to 5(7)-nerved adaxially.

9a. Larger perigynia 3.2–4.8(–5.2) mm long, beaks 0.8–1.5 mm long; pistillate scales acute, 3.3–4(–4.3) mm long, 2.3–2.9(–3.1) times as long as wide; achenes 1–1.3(–1.4) times as long as wide . . . . . *C. brevior*

9b. Larger perigynia (4.6–)5–5.5 mm long, beaks 1.4–2.2(–2.4) mm long; longer pistillate scales acuminate to awned, (3.7–)4–5.2(–5.6) mm long, (2.6–)2.9–3.7(–4.2) times as long as wide; achenes (1.2–)1.4–1.7 times as long as wide.

10a. Staminate and lower pistillate scales acuminate-awned, the tip white to brownish-hyaline, membranaceous, often ± curled, the midvein evanescent before the tip; beaks of larger perigynia 2–2.6(–2.8) mm long; the body (1.3–)1.4–2.1 times as long as the beak . . . . . *C. missouriensis* sp. nov.

10b. Staminate and lower pistillate scales acuminate, the tip firm and herbaceous, flat or inrolled, with the midvein prominent to the tip; beaks of larger perigynia 1.4–2.2 mm long; the body 1.8–2.6(–3) times as long as the beak . . . . . *C. shinnersii* sp. nov.

7b. Spikes on larger culms 2 to 4(5), rounded at the base, the terminal one often lacking a conspicuous staminate base; inflorescences 1.2–3(–3.6) cm long with the lowest internodes 1.5–7(–13) mm long; perigynium body (0.7–)0.9–1.6 times as long as wide.

11a. Achenes of larger perigynia 0.9–1.3 mm wide, elliptic to narrowly oblong, 1.3–1.6 times as long as wide; larger perigynia 1.8–2.8(–3) mm wide, squarrose-spreading at maturity, (25)30 to 80 per spike . . . . . *C. molesta*

11b. Achenes of larger perigynia 1.35–1.8 mm wide, broadly oblong to ± orbicular, 1–1.3 times as long as wide; larger perigynia (2.1–)2.5–3.4(–3.5) mm wide, appressed-ascending at maturity, (10)15 to 40(45) per spike.

12a. Perigynia nerveless or faintly and irregularly 1- to 5-nerved over achene on adaxial surface, the bodies (2–)2.3–3.2 mm long, ± orbicular (0.7–)0.9–1.1(–1.3) times as long as wide; pistillate scales mostly acute, about as long as to 0.7(–0.9) mm shorter than the subtended perigynium (flattened and measured separately); widespread . . . . . *C. brevior*

12b. Perigynia strongly (3)4- to 7-nerved over achene on adaxial surface, the bodies (2.7–)3–4 mm long, broadly ovate to broadly elliptic, less often ± orbicular, (0.9–)1–1.6 times as long as wide; pistillate scales mostly obtuse, 0.7–1.7 mm shorter than the subtended perigynium (flattened and measured separately); Ozark Mountains, Cumberland Plateau, central Appalachians . . . . . *C. molestiformis*

3b. Larger perigynia 5.5–8(–8.7) mm long, (3.1–)3.3–6.1 mm wide (except sometimes in *C. bicknellii* and *C. shinnersii*), with beaks (1.4–)1.6–2.5(–3.4) mm long; perigynia thin and ± wafer-like, ± biconvex around the achene, the bulge often prominent on both faces of the perigynia.

13a. Larger perigynia 4–6.1 mm wide, nerveless over achene adaxially, or nearly so; at least the lower staminate scales, especially of the terminal spike (and sometimes the lowermost pistillate scales) with the midrib excurrent as a scabrous awn 0.1–0.9(–2.4) mm long; larger culms with (2)3 to 4(5) spikes . . . . . *C. tetrastachya* (= *C. brittoniana*)

13b. Larger perigynia (2.5–)2.7–4.8 mm wide, (0)1- to 8-nerved over achene adaxially; staminate and pistillate scales obtuse to acuminate-awned, but the midrib not excurrent as a scabrous awn; larger culms with (3)4 to 7(11) spikes.

14a. Leaf sheaths finely papillose, at least near the apex; perigynia membranaceous, the brown achene clearly visible through the translucent adaxial face of the perigynium, usually with reddish brown tinged wings, strongly and evenly 4- to 8-nerved adaxially over achene; pistillate scales usually reddish brown; plants in small clumps (usually < 25 culms) in dry to mesic habitats . . . . . *C. bicknellii*

14b. Leaf sheaths smooth; perigynia herbaceous, opaque, achene not clearly visible through the adaxial face of the perigynium, with greenish or pale brown wings, finely and irregularly (0)1- to 7-nerved over achene adaxially; pistillate scales pale yellowish brown to brown; plants often in dense, large clumps (up to 200 culms) in wet habitats.

15a. Staminate and pistillate scales acuminate-awned, the tip white to brownish hyaline, membranaceous, often ± curled, the midvein evanescent before the tip;

beaks of larger perigynia 2–2.6(–2.8) mm long; the body (1.3–)1.4–2.1 times as long as the beak . . . . . *C. missouriensis* sp. nov.

15b. Staminate and pistillate scales obtuse to acuminate, the tip firm and herbaceous, flat or inrolled, with the midvein prominent to the tip; beaks (1.2–)1.5–2.1(–2.3) mm long; the body 1.9–3 times as long as the beak.

16a. Larger perigynia (5.6–)6–7.1 mm long, 3.3–4.6(–4.8) mm wide, exceeding the subtending scale by 1.5–2.6 mm; staminate and lower pistillate scales obtuse to acute; pistillate scales (2.2–)2.4–3.2(–3.4) times as long as wide . . . . . *C. opaca* comb. nov.

16b. Larger perigynia 4.8–6(–6.3) mm long, (2.5–)2.7–3.8 mm wide, exceeding the subtending scale by (0.4–)0.6–1.4(–1.6) mm; staminate and lower pistillate scales acuminate; pistillate scales (2.6–)2.9–3.7(–4.2) times as long as wide . . . . . *C. shinnersii* sp. nov.

Species Treatment

1. Carex bicknellii Britton, in Britton & Brown, Ill. Fl. 1: 360. 1896. *Carex straminea* var. *crawei* F. Boott, Ill. Carex 3: 121. pl. 388. 1862, not *Carex bicknellii* E. G. Camus, in LeComte, Not. Syst. 1: 239. 1910 [= *Carex xanthocarpa* Bicknell]. TYPE: U.S.A. Michigan: *Crawe s.n.* (lectotype, here designated, K).

Caespitose in small clumps of up to 25 culms from short, thick, woody rhizomes; fertile culms (35–)40–110 cm tall, erect, trigonous, smooth or slightly scabrous-angled below inflorescence; bladeless basal sheaths dark brown to nearly black, disintegrating into conspicuous, short, dark brown fibers. Leaves 3 or 4, on lower 1/5–1/3 of the culm; blades 2.5–25 cm long, 2–5 mm wide, plicate, papillose adaxially, especially distally, the margins and midrib antrorsely scabrous distally; leaf sheaths ca. 2–16 cm long, tightly enveloping culms, papillose, at least on the main veins, green, the intervenal areas of the larger sheaths sometimes pale and with scattered septae; ventral sheaths with distinct V- to Y-shaped hyaline area reaching up to 20 mm below the orifice, the apex concave or truncate, extending up to 2.5 mm above the base of the blade; ligules 1–5 mm long, rounded to acute, the free portion entire and up to 1 mm long. Vegetative culms annual, few, ca. 20–60 cm tall, leaves 6 to 8, the lower 2 or 3 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences 2.4–6.2 cm long, erect to arched or nodding, the spikes overlapping or the lowest separate, the lowest spikes 5–17 mm apart, spikes single at nodes, sessile; lowermost bracts 4.5–12 mm long, scale-like, but usually aristate-tipped, sheathless, upper bracts much reduced; spikes 3 to 6(8), gynecandrous, 7–21 mm long, globose to ovoid or turbinate, bases rounded to long-tapering, apices rounded, pistillate portion 5.5–11 × 5.5–12 mm, ca. 12- to 40-flowered, staminate portion 1.5–11 × 2–2.5 mm, ca. 4- to 20-flowered. Pistillate scales 3.1–5.4 × 1.2–2 mm, reaching at most to the base of the perigynium beak, usually (1–)1.4–2.3 mm shorter than perigynia, lance-ovate to ovate, 1.9–3.2 times as long as wide, obtuse to acute or the uppermost acuminate, usually strongly reddish brown with narrow green center, 1-nerved with the nerve prominent nearly to the apex. Staminate scales 3.6–4.8 × 1.3–2.4 mm, ovate to lance-ovate, obtuse to acute, yellowish brown to reddish brown tinged, with green center and narrow hyaline margins, 1-nerved. Perigynia (4.5–)5.1–6.7(–7.1) × (2.4–)2.8–4.2 mm, 1.3–2.2 times as long as wide, glabrous, sessile, loosely ascending to somewhat spreading, concavo-convex, 0.5–0.7 mm thick, thin and membranous, very translucent over achene; bodies broadly elliptic to broadly ovate or nearly orbicular, 3.3–5.2 mm long, 1.1–1.7 times as long as wide and 2–3.7 times as long as beak, widest 1.5–2.5 mm above base, broadly thin-winged, wings 0.8–1.2 mm wide, the margins finely serrulate except near base and often erose, scalloped, or with an irregular tooth and not symmetric, contracted into a beak, green to pale whitish green with strongly reddish brown tinged wings, with 4 to 8 sharp nerves adaxially over achene, 6 to 9 nerves abaxially over achene and 2 to 3 nerves in winged margin; beaks (1.2–)1.4–2.2 mm long, strongly flattened and serrulate-margined to apex, the dorsal suture copper-brown, the apex bidentate with scabrous-margined teeth 0.1–0.5 mm long, distance from summit of achene to tip of beak 2.4–3.7 mm long. Achenes 1.6–2.2 × 1.1–1.6 mm, 1.2–1.6 times as long as wide, biconvex, elliptical to ± oblong, pale to dark brown, short-stipitate at base, apiculum 0.1–0.4 mm long; style straight; stigmas 2. Anthers 3, (2.4–)2.8–4.2 mm long. Chromosome numbers: $n = 38$ II, 39 II.

The only previous report of a chromosome number for this species was $n = 38$ II (Table 1). Tanaka (1942) reported $n = 37$ II for *Carex bicknellii*. He obtained his material from Montréal, almost certainly through the very active and well known seed exchange of the Montréal Botanical Gardens. Plants

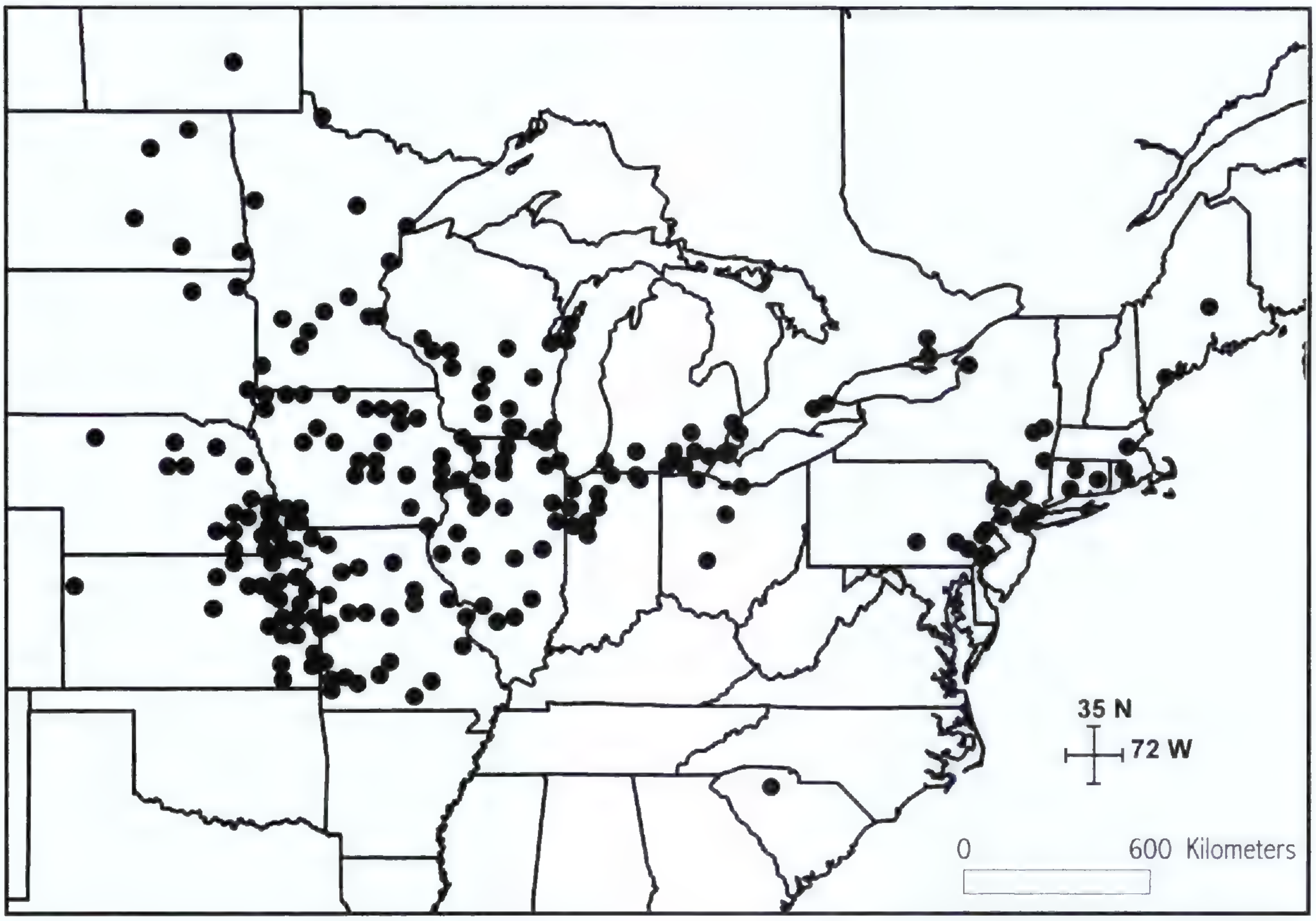


Figure 7. Geographical distribution of *Carex bicknellii*.

cultivated as *C. bicknellii* at the Montréal Botanical Gardens from 1936 to 1944 were brought in from a wild population at Contrecoeur, Québec (S. Hay, pers. comm. 2001). Material from this population has been determined by us as *C. merritt-fernaldii*. Tanaka's (1942) count for *C. bicknellii* is therefore here reported under *C. merritt-fernaldii*. Our additional counts of two plants from Illinois and two from Missouri all were $n = 38$ II or 39 II (Table 1).

Carex bicknellii mainly ranges from Missouri and southeast Kansas northward to southeast Manitoba and the western Lake Erie region (Fig. 7). Here it would have been a characteristic element of dry to mesic prairie communities. Disjunct populations occur in western Kansas, and the eastern Lake Ontario region. This species is also frequent on serpentine barrens, dry sandy or rocky fields, open woods, and thickets in an area from Connecticut to southeastern Pennsylvania and northern New Jersey, with colonies extending increasingly sparingly northward to southern Maine. The remarkable population from South Carolina is a component of a disjunct prairie community (Hill & Horn, 1997).

Putative hybrids with other species: none known.

Boott (1862) cited four syntypes for *Carex straminea* var. *crawei*, upon which *C. bicknellii* is based: Michigan, *Crawe*; Wisconsin Prairies, *Lapham*; Darby Plains, Ohio, *Sullivant*; and Connecticut, *Barratt*. All the syntypes are extant in Boott's herbarium (K). Mackenzie (1931) noted for *Carex straminea* var. *crawei* "Type from Michigan." Though this notes only one of the four syntypes, it does not constitute a lectotypification, because it does not identify a single specimen as the lectotype. We concur, however, that the *Crawe* collection is the most suitable for lectotypifying *C. straminea* var. *crawei* because it was used by Boott for his illustration, and have selected the sheet in Boott's Herbarium.

Representative specimens. CANADA. **Manitoba:** Saskatchewan Plains, 1 Aug. 1872, *J. Macoun s.n.* (GH). **Ontario:** Brant Co., Brantford Twp., TCG prairie S of Hardy Rd., *W. Bakowsky 285* (TRTE); Essex Co., Windsor, Ojibway Prairie, N side of Titcombe Rd. between Matchette and Malden Sts., *M. J. Oldham 2782* (MICH); Hamilton-Wentworth Reg. Mun., Ancaster Twp., SW corner Paddy Greens Rd. and Powerline Road, *A. Goodban 93-002* (TRTE); Hastings Co., Tyendinaga Twp., approx. 3 km WSW of Deseronto, *P. M. Catling & M. Oldham 20321* (MICH); Lambton Co., Walpole Island, *L. O. Gaiser 3614* (DAO); Lennox and Addington Co., Sheffield Twp., middle shore of Mellon Lake, 2 Aug. 1994, *P. M. & V. R. Catling s.n.* (MICH); Rainy River Dist., Spohn Twp., on shore of Lake of the Woods, *M. J. Oldham & W. D. Bakowsky 20094* (MICH). U.S.A. **Connecticut:** Hartford Co., Avon,

F. C. Seymour 29808 (MO); New Haven Co., Wallingford, *L. J. Mehrhoff 12725* (MICH); New London Co., Franklin, *R. W. Woodward 19512* (MO). **Illinois:** Adams Co., prairie along RR, W of Paloma, *R. A. Evers 107812* (ILLS); Cass Co., Beardstown, *S. R. Hill 29202* (MICH); Champaign Co., Urbana, *A. S. Pease 13083* (GH); Cook Co., Evanston, *A. S. Hitchcock 198* (KSC); DuPage Co., Naperville, *L. M. Umbach 871* (GH); Effingham Co., along railroad, SW of Mason, *R. A. Evers 112957* (ILLS); Henry Co., Munson Cemetery, *R. R. Clinebell 144, 146* (MO); Iroquois Co., S of Iroquois City, *R. A. Evers 68890* (NCU); JoDaviess Co., 5 mi. W of Apple River, *F. J. Hermann 8783* (GH); Kankakee Co., sand prairie, S of Talmadge, *R. A. Evers 74080* (ILLS); Knox Co., Scots Cemetery, *R. R. Clinebell 127* (MO); Lake Co., Lake Villa, *S. Virostak 1933* (F); Lee Co., Co. Line Prairie, *R. R. Clinebell 181* (MO); Macon Co., Decatur, *I. W. Clokey 1035* (GH, US); Madison Co., Taag Station, *H. Eggert s.n.* (MO); Marion Co., prairie SW of Kinmundy, *R. A. Evers 37265* (ILLS); Marshall Co., near Lawn Ridge, *V. H. Chase 1404* (GH); McDonough Co., Emmet, East Fork of La Moine River NW of Macomb, *S. R. Hill with R. D. Henry 29260b* (MICH); Ogle Co., N of Davis Jct., *E. W. Fell 499* (DAO); St. Clair Co., Hill prairie, *J. O. Neill 10859* (ILLS); Starke Co., near Wady Petra, *V. H. Chase 625* (MICH); Whiteside Co., Morrison RR, *R. R. Clinebell 143* (MO); Winnebago Co., camp S of Bell Bowl in Greater Rockford Airport, *E. W. Fell 56-115* (GH). **Indiana:** Benton Co., RR-siding 2 mi. NW of Earl Park, *F. J. Hermann 6593* (MICH), *6598* (GH); Lagrange Co., along the Pigeon River, 2 mi. E of Mongo, *C. C. Deam 20188* (PUL); Lake Co., S of Shelby near the Kankakee River, *C. C. Deam 20142* (GH); Newton Co., along Penn Central RR, Lake Village, Lake Twp., 30 May 1970, *R. Schulenberg et al. s.n.* (MOR); Pulaski Co., sand dune near Thornhope, *S. McCoy 1880* (BUT); St. Joseph Co., RR tracks, Christ the King Church, Niles Hwy., 5 June 1951, *P. E. Hebert s.n.* (DAO); Starke Co., S-side of Round Lake, 5 mi. SW of Knox, *R. M. Kriebel 9539* (PUL); Tipton Co., W of Goldsmith, 30 May 1939, *C. M. Ek s.n.* (BUT); White Co., Railroad siding, 2 mi. S of Monon, *F. J. Hermann 6062* (MICH). **Iowa:** Boone Co., Boone Prairie at jct. of Iowa 60 and US 30, *C. R. Gunn 2456* (ISC); Bremer Co., Lageschulte Prairie, 1 mi. E and 0.5 mi. N of Waverly, *C. C. Freeman 11043* (KANU); Cedar Co., along RR E of Mechanicsville, *B. Shimek 21* (GH); Chickasaw Co., New Hampton, 26 June 1926, *W. D. Spiker s.n.* (ISC); Dickinson Co., Cayler Prairie, *M. L. Grant 11568* (ISC); Emmet Co., prairies, Armstrong, 25 & 28 June 1855, *R. I. Cratty s.n.* (MO, NCU); Fayette Co., E of Hawkeye, 2 June 1921, *B. Shimek s.n.* (ISC); Floyd Co., Charles City, *Arthur s.n.* (ISC); Grundy Co., Reinbeck, *L. H. Pammel & B. B. Zimmerman 276* (ISC); Iowa Co., Marshalltown, *C. R. Ball 382* (GH, MO); Jasper Co., Rock Creek Twp., Sec. 7, 4 June 1956, *T. Van Bruggen s.n.* (BRIT); Jefferson Co., Chautauqua Park, Buchanan Twp., *C. L. Gilly 2681* (ISC); Johnson Co., Iowa City, 11 June 1889, *A. D. Hitchcock s.n.* (ISC); Jones Co., dry sand and gravel along RR tracks, Oxford Twp., *T. S. Cooperrider 1010* (NCU); Lee Co., Sec. 26, T66N, R6W, *J. L. Fults 1488* (ISC); Lyon Co., Gitchie Manitou State Park, Sioux Twp., *A. Hayden 8045* (ISC); Mills Co., 1½ mi. N of Haistings, 28 June 1983, *B. Wilson s.n.* (OMA); Montgomery Co., Erickson Prairie, *B. Wilson 3846* (MICH, OMA); Muscatine Co., SE of Salisbury bridge, 11 June 1928, *B. Shimek s.n.* (ISC); Osceola Co., 2 mi. E of Harris, *R. H. Monson 2310* (ISC); Page Co., N edge of Sec. 35, Tarkio Twp., 30 May 1989, *B. Wilson* s.n. (OMA); Pocahontas Co., Kalsow Prairie, Belleville Twp., *J. D. Brotherson 1190, 1287* (NCU); Polk Co., Aukenny, 18 June 1923, *L. H. Pammel s.n.* (ISC); Sac Co., prairie relic between Hwy. #71 and railway, *P. H. Monson 1832* (ISC); Scott Co., W Davenport, July 1897, *B. Miller s.n.* (ISC); Sioux Co., Hull, 1 July 1895, *N. Newrie s.n.* (ISC); Story Co., Ames, 16 June 1877, *J. C. Arthur s.n.* (GH); Webster Co., Fort Dodge, 14 June 1906, *R. I. Cratty s.n.* (ISC). **Kansas:** Anderson Co., 1 mi. S, 2 mi. W of Harris, *L. J. Harms 1316* (KANU); Atchison Co., ½ mi. E of N city limits of Atchison, *H. W. Blocker 579* (KSC); Bourbon Co., Hollister Wildlife Area, *R. L. McGregor 40271* (KANU); Cloud Co., 6½ mi. E of Aurora near Mulberry Creek, *S. V. Fraser 101* (KSC); Coffey Co., Wolf Creek site near Burlington, 8 June 1981, *E. W. Uhlemann s.n.* (OMA); Crawford Co., 5 mi. SW of Pittsburg, *R. L. McGregor 9972* (KANU); Douglas Co., 5 mi. S of Lawrence on Haskett St., *O. A. Kolstad & L. J. Harms 2160* (GH); Franklin Co., 4 mi. SW of Ottawa, *Hetzer 203* (KANU); Jackson Co., 4 mi. N, 4 mi. E of Holton, Prairie Lake, *O. A. Kolstad & L. J. Harms 2631* (GH, KANU); Johnson Co., 3 mi. S, 1 mi. W of jct. of Kill Creek Rd. and KS Hwy. 10, Kill Creek Prairie, *C. A. Morse 1234* (KANU, MICH); Leavenworth Co., May 1896, *A. S. Hitchcock s.n.* (KSC); Lyon Co., NE corner, 4 June 1930, *F. Agrelius s.n.* (KSC); Miami Co., Paola, *B. Rohrer 17* (KSC); Montgomery Co., Montgomery Co. State Lake area, *R. L. McGregor 40408* (KANU); Nemaha Co., 4 mi. N of Bancroft, *G. Seiler & R. Brooks 5156* (KANU); Neosho Co., Erie Township, N edge of Erie by Santa Fe RR, *W. W. Holland 377* (KANU); Osage Co., Osage County State Lake, *R. L. McGregor 40556* (KANU); Pottawattomie Co., 30 May 1899, *J. B. Norton s.n.* (GH); Riley Co., July 1897, *R. H. Pond s.n.* (GH); Saline Co., pasture land W of Salina, *J. Hancin 1510* (KSC); Shawnee Co., Topeka, May 1895, *B. B. Smyth s.n.* (KSC); Sherman Co., Goodland, 30 July 1892, *B. B. Smyth s.n.* (KSC); Wabaunsee Co., E of Wabaunsee, *P. Maus 232* (KSC); Washington Co., Washington County State Lake, 3 mi. W, 8 mi. N of Washington, *S. Stephens 53871* (KANU); Wilson Co., 7 mi. E of Fall River on K96, *O. A. Kolstad 1393* (KANU). **Maine:** Cumberland Co., Cumberland, *J. G. Blake s.n.* (US); Penobscot Co., terrace of Penobscot River, Bangor, *M. L. Fernald & C. A. Weatherby* (*Plantae Exsiccatae Grayanae 529*) (BRIT, BUT, DAO, GA, GH, ISC, KANU, MICH, MO, NCU, WIS). **Massachusetts:** Middlesex Co., Winter Pond, Winchester, *M. L. Fernald & B. Long 8993* (GH); Norfolk Co., region N of Wellesley, 19 Oct. 1907, *K. M. Wiegand s.n.* (NY). **Michigan:** Jackson Co., N of Clear Lake, *F. J. Hermann 6204* (GH, MICH, WIS); Livingston Co., Edwin S. George Reserve, *F. N. Hamerstrom, Jr. 160* (DAO, MICH); Oakland Co., Royal Oak township, 12 Aug. 1920, *C. Billington s.n.* (MICH, US); St. Joseph Co., near Colon Jct., 1893, *C. F. Wheeler s.n.* (GH). **Minnesota:** Chippewa Co., Montevideo, *L. R. Moyer 51* (US); Hennepin Co., vicinity of Minneapolis, June 1894, *J. H. Sandberg s.n.* (GH); Itasca Co. (?), Lake Pokegama Islands, *J. H. Sandberg 273* (US, WIS); Meeker Co., Litchfield, June 1892, *W. D. Frost s.n.* (GH); Norman Co., beside hwy. #32, 10 mi. S of Fertile, *J. W. Moore & E. P. Thatcher 14342* (BRIT); Pipestone Co., Pipestone National Monument, Unit 5, 7 July 1984, *D. Becker s.n.* (OMA); Redwood Co., about 7 mi. S of Sacred Heart, *J. W. Moore & C. O. Rosendahl 13318* (GH, ISC); Renville Co., granite outcrops at Morton, *J. W. Moore 13059* (US, WIS); St. Louis Co., Enger Golf Course, Duluth, *O. Lakela 5079* (BRIT); Sherburne Co., St. Cloud airport, 21 June 1984, *L. E. Lindstrom s.n.* (KSC); Washington Co., northern outskirts of Afton village near Minn.

Rte. 95, *G. B. Ownbey 5567* (BRIT, DUKE, NCU, OKL, WIS). **Missouri:** Atchison Co., 1.5 mi. E of Nodaway Co. line and 3 mi. S of C, MacKay Prairie, *D. Castaner et al. 5704* (MO); Audrain Co., 5.4 mi. W of Thompson, S side of Mo. Hwy. 22 along Norfolk and Western Railway, *A. A. Reznicek et al. 10193* (MICH, MO); Barton Co., Leroy Twp., remnant prairie lot, *D. Castaner 6899* (MO); Bates Co., Amsterdam Prairie, July 1994, *H. Loring s.n.* (MO); Caldwell Co., 1.2 mi. W of Rte. A+M Jct., ca. 9.5 mi. E of Hamilton, *A. A. & S. A. Reznicek 9840* (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Callaway Co., Kingdom City, Tucker Prairie, ca. 2.5 mi. WNW of Jct. Hwy. 54 and I-70, *A. A. Reznicek et al. 10190* (MICH, MO, VPI, WIS); Cass Co., ca. 3 mi. NW of Archie, Dorsett Hill Prairie, *T. E. Smith 2526* (MO); Christian Co., 1 mi. W of Billings, jct. Hwys. 13 and 60, 22 May 1986, *D. Castaner s.n.* (MO); Gentry Co., along road Z, 2.8 mi. W of Berlin, *J. A. Steyermark 76302* (BRIT); Holt Co., Little Tark Prairie, ca. 1 mi. W of County Hwy. C and 1.75 mi. N of US Hwy. 59, 3 mi. E of Craig, *G. Yatskievych & B. Summers 93–199* (MO); Howell Co., Willow Springs, *F. W. Pennell 11631* (ISC); Jackson Co., Waldo Park, *B. F. Bush 652* (KSC, MO); Jasper Co., Sarcoxie, *E. J. Palmer 3674* (GH); Johnson Co., about 7 mi. NE of Warrensburg, *D. Castaner 2221* (BRIT, MO); Laclede Co., Lebanon, *F. W. Pennell 11663* (ISC); Lawrence Co., ca. 2.5 mi. E of Stotts City, *G. & K. Yatskievych et al. 97-09* (MO); Lincoln Co., Sherwood Prairie, *B. Schuette 2606* (MO); Livingston Co., RR embankment NE of Chillicothe, *S. Sparling 834* (ISC); Macon Co., Long Branch State Park, ca. 1.5 mi. NNE of jct. Rte. 72 and 62, NE of Bertrand, *P. M. McKenzie with K. McCarty 1588* (MICH, MO); Moniteau Co., along Hwy. 50 W of California, *J. A. Steyermark 65475* (F); Newton Co., Diamond Grove Prairie Natural Area, ca. 3.5 mi. W of Diamon and 1 mi. N of County Hwy. V, *G. Yatskievych et al. 94-81* (MO); Nodaway Co., ca. 1/4 mi. W of NWSMU–Maryville campus, *T. E. Smith 3233* (MO); Pettis Co., Drover's Prairie, 10 mi. S of Sedalia on Hwy. 65, 1 mi. W, 22 June 1989, *K. Kindscher s.n.* (KANU); St. Francois Co., St. Francois State Park-Coonville Creek fen, *P. M. McKenzie with B. Jacobs 1697* (MICH, MO); St. Louis Co., Normandy, St. Louis, 18 May 1918, *J. R. Churchill s.n.* (GH, ISC); Shannon Co., *B. F. Bush 16* (US); Webster Co., S-side of Hwy. US 60 along St. Louis–San Francisco RR, *A. E. Brant & R. E. Gereau 556* (GH). **Nebraska:** Cass Co., Weeping Water, *J. M. Bates 5121* (GH); Fillmore Co., 2½ mi. W of Fairmont, *S. Stephens 48572* (KANU); Holt Co., Inman, 20 June 1899, *J. M. Bates s.n.* (GH); Johnson Co., 4 mi. S and 1/4 mi. E of Tecumseh, *S. Stephens 3892* (KANU); Lancaster Co., Lincoln, Flader prairie, *W. Kiener 19227* (BRIT, DAO); Pawnee Co., 2 mi. N and 3 mi. E of Burchard, *S. Stephens 53698* (KANU); Richardson Co., SW of Salem, *H. C. Reynolds 1655* (DAO); Sarpy Co., Fricke Prairie, about 1.3 mi. ENE of 72nd and Cornhusker, *S. Lamphere 1179* (OMA). **New Jersey:** Bergen Co., Closter, *C. F. Austin s.n.* (GH); Passaic Co., sandy fields, Clifton, 28 June 1917, *J. A. Ruth s.n.* (US); Sussex Co., between Stockholm and Hamburgh, 19 May 1894, *C. L. Pollard & W. M. Van Sickle s.n.* (US); Union Co., #9 Park Ave., Plainfield, *W. D. Miller 535* (US); Warren Co., near Stillwater, *L. Griscom 9735* (GH). **New York:** Albany Co., Glenmont, *H. D. House 7875* (GH); Dutchess Co., Little Stissing Mountain, 14 May 1881, *C. H. Peck s.n.* (GH); Jefferson Co., Watertown, *J. B. Crawe s.n.* (GH); Orange Co., Durland Hill, Chester, *H. K. Svenson 8425* (DAO); Rensselaer Co., Troy, *Williams s.n.* (GH); Rensselaer Co., N of North Chatham close to Columbia Co. line, *H. D. House 27318* (US); Sussex Co., S of Sussex, Long Island, Cold Spring Harbor, *S. A. Cain 112* (BRIT, MO). **North Dakota:** Benson Co., Leeds, 23 July 1912, *J. Lunell s.n.* (BUT); Cavalier Co., Langdon, *S. L. Rider 113* (F); LaMoure Co., Adrian, *H. F. Bergman 1807* (OKL); Richland Co., Walcott, *O. A. Stevens 1259* (US, WIS); Stutsman Co., Central Grasslands Research Station, *C. L. Lura 217* (NDA). **Ohio:** Crawford Co., Dallas Twp., Daughter Savanna, W side Marion-Melmore Road, 1 mi. N of SR 294, *G. Schneider 1998:62, E. Reed* (OS); Erie Co., Old Woman Creek State Nature Preserve, *J. K. Bissell et al. 1990:064* (MICH); Lucas Co., W side of sec. 11, about 7 mi. NW of Maumee, *C. C. Deam 5962* (IND); Madison Co., Monrow Twp., W. Pearl King Prairie Oak Grove, NW corner Brown Road and Sanford Road (CR 27), *G. Schneider 1993:243* (OS). **Pennsylvania:** Chester Co., serpentine barrens, Westtown, *J. H. Painter 656* (GH, MO); Delaware Co., Williamson, *F. W. Pennell 3783* (MICH, MO); Montgomery Co., along Schuylkill River, Ivy Rock, *B. Long 7330* (GH). **Rhode Island:** county, town, and date unknown, *J. W. Congdon s.n.* (US). **South Carolina:** Union Co., Co. Rt. 25, 0.95 mi. W of Co. Rt. 33, W of Buffalo, *S. R. Hill 25886* (MICH). **South Dakota:** Brown Co., 17 mi. N, 9 mi. W of Aberdeen, *S. Stephens 48891* (KANU); Roberts Co., Seiche Hollow, 8 mi. W, 6 mi. N of Sisseton, *S. Stephens & R. Brooks 14490* (KANU). **Wisconsin:** Brown Co., Ashwaubenon, June 1885, *J. H. Schuette s.n.* (F, GH); Dane Co., along RR right-of-way, W edge of Dunn's Marsh, Madison, *J. H. Zimmerman 1695* (DAO); Door Co., Sturgeon Bay, 11 July 1885, *J. H. Schuette s.n.* (F); Green Lake Co., Berlin, *P. E. Hebert 1287* (ND); Jackson Co., along Rte. 54 about 4.7 mi. E of Black River Falls, *V. E. McNeilus 89-493* (MICH, MO); Juneau Co., prairie by Hwy. 12–16, on C.M. St. P. & P. RR bank, Delton, *J. H. Zimmerman 2003* (DAO); Monroe Co., Sparta, *H. C. Benke 1535* (F, US); Racine Co., Racine, 1880, *J. J. Davis s.n.* (GH); Rock Co., N of Newark Road, S ½ of Sec. 13, Newark Twp., *E. & L. Musselman 4603* (NCU); Rock Co., prairie remnant, T2N, R13E, *T. S. Cochrane 698* (NCU, WIS).

2. Carex merritt-fernaldii Mackenzie, Bull. Torrey Bot. Club 49: 370. 1922 [1923]. TYPE: U.S.A. Maine: Penobscot Co., gravelly esker, lower Penobscot Valley, Orono, 3 July 1897, *M. L. Fernald s.n.* (holotype, GH; isotypes, GH, MO).

Carex brevior var. *pseudofestucacea* Farwell, Pap. Michigan Acad. Sci. 2: 18. 1923 [1924]. *Carex festucacea* sensu Fernald, Proc. Amer. Acad. Arts 37: 477. 1902, not *Carex festucacea* Schkuhr ex Willd., Sp. Pl. 4(1): 242. 1805. TYPE: U.S.A. Maine: Penobscot Co., gravelly esker, lower Penobscot Valley, Orono, 3 July 1897, *M. L. Fernald s.n.* (lectotype, here designated, GH; isolectotypes, GH, MO).

Caespitose in dense clumps of up to ca. 25(to 30) culms from very short, woody rhizomes; fertile culms 40–120 cm tall, erect, trigonous, smooth except for finely scabrous angles just below inflorescence; bladeless basal sheaths pale to dark brown, disintegrating into short, brown fibers. Leaves 3 to 5, on lower 1/5–1/3 of the culm; blades 2–40 cm

long, 1.5–4.5 mm wide, plicate, glabrous or papillose adaxially, the margins and midrib smooth to antrorsely scabrous; leaf sheaths ca. 1.5–17 cm long, tightly enveloping culms, papillose, green, the intervenal areas of larger sheaths sometimes pale and with scattered green septae; ventral sheaths with a distinct Y-shaped hyaline area reaching 0–7(–10) mm below the orifice, its apex concave or truncate, extending 0–1.5 mm above the base of the blade; ligules 1.5–5 mm long, rounded, the free portion entire and up to 1.7 mm long. Vegetative culms annual, few, ca. 20–45 cm tall during fruiting season, leaves 5 to 9, the lower 2 or 3 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences (1.8–)2.2–6.1 cm long, erect to arched or nodding, the spikes overlapping or the lower 2 to 4 well separated, the lowest spikes 2–13 mm apart, spikes single at nodes, sessile; lowermost bracts 3–12(–17) mm long, rarely aristate bristle-tipped, seldom exceeding the spike, sheathless, upper bracts much reduced; spikes (4)5 to 8(9), gynecandrous, 8–20 mm long, globose to ovoid, bases rounded to acute, apices obtuse, pistillate portion 7–11 × 6–8(–10) mm, ca. 15- to 60-flowered, staminate portion 1–9.5 × 1–2 mm, ca. 4- to 12-flowered. Pistillate scales 3.2–4.5(–4.7) × 1–1.7 mm, reaching from the middle to near the apex of the perigynium beak, 0.4–1 mm shorter than the perigynia, 2.2–3.4 times longer than wide, lanceolate to narrowly ovate, acute, pale yellow to medium brown, with narrow yellowish green center and hyaline margins, 1-nerved or faintly 3-nerved, the midnerve extending essentially to the tip. Staminate scales 3–4.6 × 1.4–2 mm, ovate to lanceolate, obtuse to acuminate, pale yellow to light brown, with narrow yellowish green center and hyaline margins, 1-nerved or faintly 3-nerved. Perigynia 3.6–5.2(–5.5) × 2.5–3.4 mm, 1.3–2.3 times as long as wide, glabrous, sessile, appressed-ascending, concavo-convex except over the achene, 0.5–0.8 mm thick, ± thin and membranous, translucent over achene; bodies elliptic to ± orbicular, 3–4.1 mm long, 1–1.4 times as long as wide and 2.8–4.2 times as long as beak, widest 1.2–2.2 mm above base, broadly thin-winged, wings 0.6–1.1 mm wide, the margin finely serrulate except near base, often erose, scalloped, or with irregular teeth in the shoulder area, abruptly contracted into a beak, the wing margin pale yellow to yellowish brown tinged, faintly and irregularly 0- to 5(6)-nerved adaxially over achene, 6- to 8-nerved abaxially over achene and 2- or 3-nerved in the winged margin; beaks 0.7–1.4 mm long, strongly flattened and serrulate-margined to apex, the dorsal suture hyaline to brown, the apex inconspicuously bidentate with teeth 0.1–0.4 mm long, distance from summit of achene to tip of beak 1.8–3.1 mm. Achenes 1.4–1.8 × 1.3–1.5 mm, 1.1–1.4 times as long as wide, biconvex, elliptical to ± orbicular, pale to dark brown, short-stipitate at base, apiculum 0.1–0.4 mm long; style straight; stigmas 2. Anthers 3, 1.3–2.6 mm long. Chromosome number: $n = 35$ II, 37 II.

Previous reports of the chromosome number for *Carex merritt-fernaldii* were $n = 35$ II (Tanaka, 1942) and $n = 37$ II (Tanaka, 1942; Rothrock & Reznicek, 1998). These plants came from near Montréal, Canada (Tanaka), and Strafford Co., New Hampshire. The new report of $n = 37$ II (Table 1) comes from Lucas Co., Ohio, a disjunct population forming the southern extreme of this species' range.

Carex merritt-fernaldii occurs from eastern Manitoba eastward to southern Québec, Maine, and barely into New Brunswick and south to southwestern Wisconsin and northwestern Ohio (Fig. 8). It is frequent in parts of New England, reaching as far south as Long Island, New York. It is a species of early successional communities, appearing, presumably out of the soil seed bank, after physical disturbance or fire, and gradually dying out as the habitat matures. Typical habitats include sandy or gravelly roadsides and ditch banks, sand barrens, gravel and sand pits, and rock ledges, always in relatively sterile, acidic soils. Because *C. merritt-fernaldii* requires open habitat with well-drained, leached, acidic, sandy or gravelly soils, it is lacking in large portions of southern Ontario, southern Michigan, and western New York State where calcareous or finer textured soils predominate. Reports of this species from Indiana are based upon misidentifications.

Putative hybrids with other species: none known.

Vegetatively, *C. merritt-fernaldii* and *C. bicknellii* are very similar. Both possess coriaceous herbage, stocky, papillose culm bases, and relatively few shoots per tussock. In flower or fruit, the two species can be separated as described in the key. Anthers of *C. merritt-fernaldii* are notably shorter. Likewise the perigynia of *C. merritt-fernaldii* are, on average, shorter (4.18 ± 0.35 mm (N = 30) compared to *C. bicknellii,* 5.64 ± 0.53 mm (N = 33), Fig. 9) as well as narrower. Their beaks, compared to *C. bicknellii,* are more abruptly tapered from the body. Also, in *C. merritt-fernaldii* the ventral nerves over the achene are not only faint, but average near 2 compared to greater than 5 for *C. bicknellii.* Achene length and shape further differentiate the two species. Those of *C. bicknellii* have an average length of 1.95 ± 0.09 mm compared to

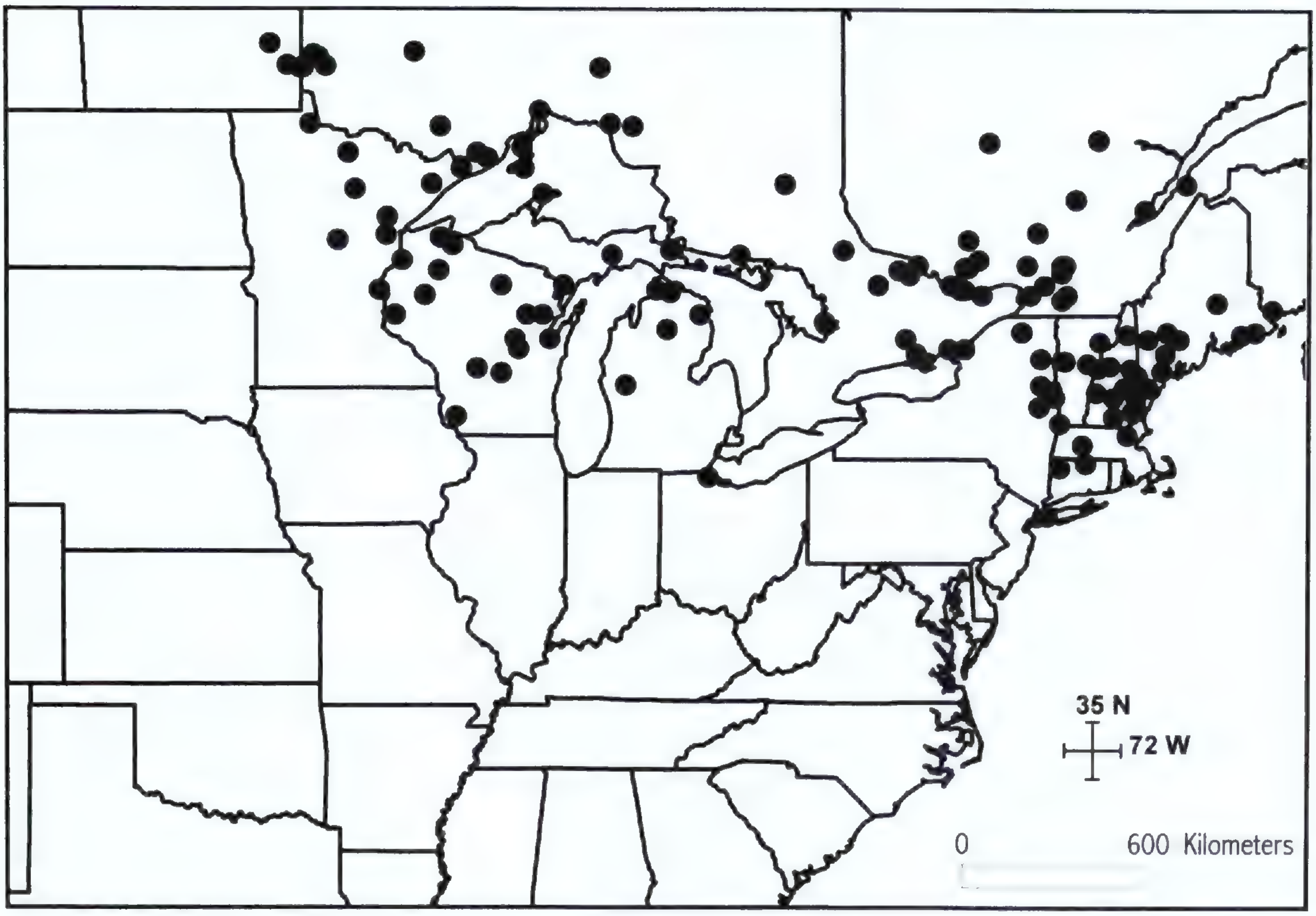


Figure 8. Geographical distribution of *Carex merritt-fernaldii*.

only 1.67 ± 0.10 mm for *C. merritt-fernaldii* (Fig. 9). However, both species have achene widths of approximately 1.3 mm. Inflorescences of *C. merritt-fernaldii* may have as many as 8(9) spikes, while those of *C. bicknellii* typically range from 3 to 6.

In spite of the differences between these sedges, the xeric environment can result in sufficient phenotypic plasticity to occasionally make separation based upon quantitative characters difficult. Mature material resolves this problem in that *C. bicknellii* perigynia possess translucent, reddish brown tinged wings and pistillate scales with reddish brown coloration. In contrast, *C. merritt-fernaldii* retains a yellowish tone to its perigynia and scales into maturity.

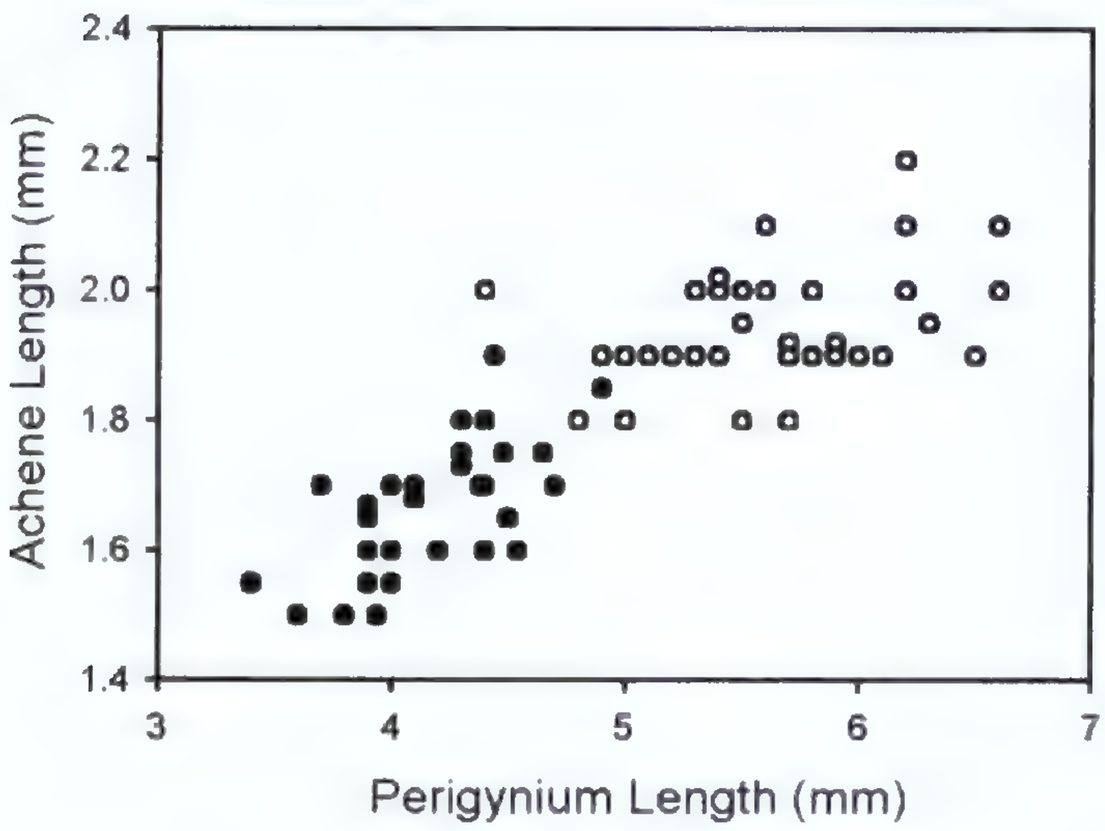


Figure 9. Scatter plot of perigynium length and achene length of *Carex bicknellii* (circles) and *C. merritt-fernaldii* (dots).

Both *Carex merritt-fernaldii* and *C. brevior* var. *pseudofestucacea* were explicit replacements for the species Fernald (1902) described under the misapplied name "*Carex festucacea* Schkuhr." However, while Mackenzie (1922) provided his own careful description of *C. merritt-fernaldii* and designated a holotype, Farwell (1923) provided only a reference to Fernald's description. The lectotypification of Farwell's name, therefore, must be based on specimens Fernald used in his description of his "*Carex festucacea* Schkuhr." The Fernald collection cited by Mackenzie as the holotype of *C. merritt-fernaldii* fits this criterion, and we choose as lectotype of the Farwell name the holotype of *Carex merritt-fernaldii*.

Representative specimens. CANADA. **Manitoba:** Lac Du Bonnet, *A. J. Breitung 7462* (DAO); near Rennie, *R. Sparling 234* (DAO); Lake Winnipeg Valley, 1857, *Bourgeau s.n.* (GH); 4 mi. SE of Caddy Lake, *D. Löve & H. J. Scoggan 6483* (WIN). **New Brunswick:** Charlotte Co., summit of Chamcook Mtn., *H. R. Hinds 11482* (UNB). **Ontario:** Algoma Dist., Hwy. 17, ca. 3 km E of Cutler, Serpent River IR 7, *M. J. Oldham & M. Delisle-Oldham*

9624 (Hb. C. T. Bryson, MICH); Carleton Co., Torbolton Twp., Constance Bay area, *J. A. Calder 406* (DAO); Frontenac Dist., Kingston Mills, 30 June 1906, *A. B. Klugh s.n.* (DAO, GH); Kenora Dist., Gundy Twp., Ingolf, *M. J. Oldham 9813* (DAO, MICH, TRTE); Rainy River Distr., Hwy. 11, 62.4 road mi. E of Fort Francis, *M. J. Oldham & M. Delisle-Oldham 9756* (MICH); Renfrew Co., Stafford Twp., Shady Nook, *W. H. Minshall 2091* (F); Simcoe Co., Tiny Twp., near Macey Lake, ca. 6.5 km NW of Penetanguishene Post Office, *M. J. Oldham et al. 18101* (MICH); Thunder Bay Dist., N end of Government Bay, White Lake, ca. 16 mi. NW of town of White River, *E. G. Voss 10472* (DAO, MICH); Lake Nipigon, 11 July 1884, *J. Macoun s.n.* (GH); Longlac, *E. Lepage 38130* (DAO, GH). **Québec:** Lac à Beauce, 8 mi. S of LaTuque, *A. & D. Löve 7249* (DAO, MT); Cté. Berthier, Lanoraie, *FF. Marie-Victorin & Rolland-Germain 49214* (F, GH, MT); Cté. Gatineau, Parc de la Gatineau, *D. Gagnon S1M–5* (MT); Cté. Iberville, Mont-Saint-Gregorie, 28 June 1949, *M. Raymond s.n.* (MT); Cté. Lac St.-Jean, Lac Val Jalbert, 8 July 1953, *L. Cinq-Mars s.n.* (MT); Cté. Montmorency, Cap-Tourmente, Saint-Joachim, *V. Gerardin & G. Lemieux 4560* (DAO); Cté. Pontiac, Bristol Twp., Pontiac Station on Ottawa River, *J. A. Calder & A. J. Breitung 4800* (DAO, MT); Cté. Rouville, Rougemont, *F. Rolland-Germain 6092* (BRIT, GH, MO, NY). U.S.A. **Connecticut:** Lichtfield Co., 1 mi. S of Bethlehem, *F. J. Hermann 11874* (MICH); Tolland Co., Union E of jct. I-84 (E) and Rte. 190, *A. A. Reznicek, L. Mehrhoff et al. 10323* (CONN, MICH). **Maine:** Androscoggin Co., Leeds, 23 July 1916, *C. H. Knowlton s.n.* (KANU); Cumberland Co., Standish, Sebago Lake, *A. H. Norton & H. Fuller 12594* (MO, NHA); Franklin Co., Farmington, 9 July 1911, *C. H. Knowlton s.n.* (MO); Hancock Co., Hwy. 182 at jct. with road to Tunk Mountain, ca. 11 mi. W of Cherryfield, *A. A. & S. A. Reznicek 9637* (BRCH, Hb. C. T. Bryson, KNK, MICH); Oxford Co., 5.9 mi. W of West Bethel, *A. A. & S. A. Reznicek 9119* (BRIT, Hb. C. T. Bryson, MICH, TAES, VDB); Penobscot Co., Veazie, *O. W. Knight 4550* (MICH, NHA, NY); Washington Co., 5.3 mi. NW of Jonesboro (at US 1), *A. A. & S. A. Reznicek 10067* (BRCH, Hb. C. T. Bryson, DAO, KNK, MAINE, MICH, TRTE, UNB, VDB, VPI, WIN); York Co., Hollis, 3 mi. W of Bar Mills, *A. H. Norton et al. 17793* (NHA). **Massachusetts:** Hampshire Co., King Street, Northampton, *H. E. Ahles 79993* (APCR); Middlesex Co., Melrose, 29 June 1876, *T. Morong s.n.* (F, NY); Worcester Co., South Ashburnham, on sandy RR embankment, *F. F. Forbes 871* (GH). **Michigan:** Cheboygan Co., Douglas Lake, *J. H. & L. S. Ehlers 2363* (MICH, NY); Chippewa Co., Sheldrake, *M. L. Fernald & A. S. Pease 3161* (GH, MICH); Emmet Co., N of Pellston, *L. S. Ehlers 296* (MICH, NY); Keweenaw Co., E of Lake Bailey, *F. J. Hermann 7781* (MICH, NY); Muskegon Co., Muskegon, *McClatchie 48* (GH); Schoolcraft Co., dry sandy plain near Driggs, *M. L. Fernald & A. S. Pease 3163* (GH). **Minnesota:** Carlton Co., June 1891, *J. H. Sandberg s.n.* (MO, US); Cook Co., W side of North Fowl Lake, *F. K. Butters, E. C. Abbe & G. W. Burns 669* (GH); Crow Wing Co., Garrison, June 1892, *E. P. Sheldon s.n.* (DUKE, KANU, US); Hennepin Co., shady hillsides, *J. H. Sandberg 5* (BH); Lake of the Woods Co., 1/4 mi. W of Pine Creek, Angle Inlet, *J. W. & M. Moore 10932* (NY); St. Louis Co., Prairie Lake, *O. Lakela 9355* (DAO). **New Hampshire:** Belknap Co., Rattlesnake Island, 6 June 1965, *W. H. Berry, Jr. & A. R. Hodgdon s.n.* (NHA); Carroll Co., Effingham, *F. C. Seymour 19835* (MO); Coos Co., Diamond Peak, Darmouth College Grant, *A. R. Hodgdon & F. Steele 9384* (NHA); Grafton Co., Wentworth, *F. C. Seymour 25581* (BRIT, MO); Hillsborough Co., Peterborough, 25 July 1932, *L. Griscom s.n.* (F); Rockingham Co., Fremont, off Ridge Rd., *E. J. Hehre with A. R. Hodgdon 201* (MO); Strafford Co., Durham near old RR Depot, *E. J. Hehre 203* (MO); Sullivan Co., 1.8 mi. S of jct. NH Rt. 11-103 and 10, Newport, *H. E. Ahles 68478* (NHA). **New York:** Essex Co., S of St. Huberts, Keene Valley, *H. D. House 27796* (GH, NY); Franklin Co., Adirondack Park, 0.3 mi. E of Franklin Falls, *A. A. & S. A. Reznicek 9909* (BRCH, DAO, KNK, MICH, NYS); Jefferson Co., vic. of South Bay, Wellesley Island, 28–30 June 1902, *T. R. Robinson & W. R. Maxon s.n.* (F, GH); Saratoga Co., Middle Grove, 20 July 1901, *C. H. Peck s.n.* (GH); Warren Co., 1/4 mi. S of Schroon Lake outlet, near Pottersville, *H. D. House 27505* (NY); Washington Co., N of Copeland Pond, W. Fort Ann, 27 June 1918, *S. H. Burnham s.n.* (GH). **Ohio:** Lucas Co., Springfield Twp., Kitty Todd Preserve of TNC, South Piel Sand Barren, *J. K. Bissell, B. W. Danielson & J. Knoop 1993:047* (MICH). **Vermont:** Addison Co., cliffs of Massalamoo Mt., Salisbury, 5 July 1901, *E. Brainerd s.n.* (GH); Bennington Co., Pownal, Mason Hill, 18 June 1901, *J. R. Churchill s.n.* (MO); Caledonia Co., Gibson Quarry, Blue Mt., Ryegate, *F. C. Seymour 18911* (BRIT, DAO, MO); Orange Co., Palisades, Fairlee, *M. E. Mathias 149* (MO, NY). **Wisconsin:** Brown Co., Big Suamico near shore of Green Bay, 22 July 1883, *J. H. Schuette s.n.* (F); Jackson Co., shore of Lee Lake at Millston, *A. M. Peterson 374A* (WIS); Juneau Co., about 5.2 mi. N of Mauston along Co. Rt. Q, *V. E. McNeilus 87-846, 87-848* (MICH, MO, WIS); Marquette Co., Page Creek wetlands, N shore of Bright Lake, 2.7 mi. ESE of Packwaukee, *T. S. Cochrane, S. Richter & P. West 13216* (MICH, WIS); Sawyer Co., beach of pond 10 mi. E of Hayward, 22 June 1928, *L. Griscom s.n.* (GH); Waupac Co., quarry, Redgranite, 16 June 1960, *J. H. Zimmerman s.n.* (WIS).

3. **Carex missouriensis** P. Rothrock & Reznicek, sp. nov. TYPE: U.S.A. Missouri: Audrain Co., Possumwalk Rd.-Audrain Co. Rd. No. 963, ca. 0.8 mi. W of intersection with Rt. E or ca. 6.7 mi. E of the intersection of rts. 22 and 151 in Centralia, T51N, R10W, SE ¼ of the SE ¼ of the SW ¼ of the SW ¼ sec. 15, wet prairie remnant between two RR beds, 28 May 1998, *P. M. McKenzie 1811 with B. Jacobs* (holotype, MICH; isotypes, BH, BRCH, BRIT/SMU, BUT, Hb. Charles T. Bryson, DAO, F, GENT, GH, ILLS, ISC, K, KANU, KNK, MO, NEB, NY, OKL, OMA, TENN, US, WIS).

Carex straminea var. *meadii* F. Boott, Ill. Carex 3: 121. pl. 389. 1862. Syn. nov. TYPE: U.S.A. Illinois: *Mead s.n.* (lectotype, here designated, K, photo at MICH).

Caespitosae; culmi fertiles 45–110 cm alti; vaginae basales brunneae vel nigrae. Folia 3–5(–6); laminae 2.5–25 cm longae, 1.8–3.2(–4) mm latae; vaginae ca. 1–24 cm longae, laeves ventraliter herbaceae. Culmi vegetativi erecti, annui. Inflorescentiae (2–)2.5–5 cm longae, erectae, aliquando arctuatae, plus minusve congestae; spicae 3–8 gynaecandrae, ovoideae vel globosae, 8–14 × 4.5–9.5 mm, basi staminata 1–3.5 mm longa. Squamae pistillatae pallide brunneae, acuminatae vel aristatae, arista herba-

cea, albo-hyalina, ad 0.7 mm longis. Perigynia (4.6–)5–7.1 × 2.5–4 mm, ascendentia, corporibus late ellipticis vel ovatis, in rostrum serrulatum 1.7–2.6(–2.8) mm longum contracta. Achenium 1.6–2.2 × 1.2–1.6 mm, biconvexum. Stigmata 2. Antherae 3, 2.2–3.6 mm longae.

Caespitose in small to large clumps, with up to 100 culms from short, thick, woody rhizomes; fertile culms 45–110 cm tall, erect, trigonous, smooth except for finely scabrous angles just below inflorescence; bladeless basal sheaths blackened to pale purple-brown disintegrating into short, dark brown fibers. Leaves 3 to 5(6), on lower 1/6–2/5 of the culm; blades 2.5–25 cm long, 1.8–3.2(–4) mm wide, plicate, smooth or papillose adaxially, the margins and midrib smooth to antrorsely scabrous; leaf sheaths ca. 1–24 cm long, ± tightly enveloping culms, smooth, yellow-green, the intervenal areas sometimes pale and with scattered septae; the ventral surface with indistinct Y-shaped hyaline area reaching up to 8 mm below the orifice, its apex concave or truncate, extending 0–2 mm above the base of the blade; ligules 2–4 mm long, rounded, the free portion entire and up to 0.5 mm long. Vegetative culms annual, few, ca. 20–90 cm tall during fruiting season, leaves (6)8 to 14, the lower 3 or 4 leaves evenly spaced along the culm, the rest clustered apically. Inflorescences (2–)2.5–5 cm long, erect or occasionally arched or nodding, the spikes overlapping or congested (the lowest sometimes separated), the lowest spikes 4–10(–14) mm apart, spikes single at nodes, sessile; lowermost bracts 5–14 mm long, rarely aristate bristle-tipped, seldom exceeding the spike, sheathless, upper bracts much reduced; spikes 3 to 8, gynecandrous, 8–14 mm long, globose to ovoid or conic, bases rounded to acute, apices acute, obtuse, or rounded, pistillate portion 7–12 × 4.5–9.5 mm, ca. 20- to 55-flowered, staminate portion 1–3.5 × 1.8–3 mm, ca. 9- to 26-flowered. Pistillate scales 3.7–4.9(–5.6) × (1–)1.3–1.8 mm, reaching from the base to the middle of the perigynium beak, (1–)1.7–2.6 mm shorter than the perigynium, 2.4–3.1 times as long as wide, lanceolate or lance-ovate, concave proximally, acuminate, with a delicate, membranaceous, usually whitish-hyaline and curled or flexuous awn up to 0.7 mm long, pale yellowish brown or occasionally pale reddish brown tinged, with narrow yellow-brown or yellow-brown and green center and broad hyaline margins, 1-nerved or faintly 3-nerved, the midnerve not extending into the awn. Staminate scales 3–5 × 1–2 mm, ovate to lance-ovate, obtuse to acuminate, yellowish brown and sometimes pale reddish brown tinged, with narrow band and broad hyaline margins, 1-nerved or faintly 3-nerved. Perigynia glabrous, sessile, (4.6–)5–7.1 × (2.5–)3.1–4 mm, 1.4–2.3 times as long as wide, loosely ascending, flat or concavo-convex except over the achene, 0.5–0.7 mm thick, herbaceous, ± opaque over achene; bodies broadly elliptic to ovate, (2.4–)3–4.7 mm long, 0.9–1.3(–1.5) times as long as wide and (1.3–)1.4–2.1 times as long as beak, widest (1.2–)1.4–2.1 mm above base, broadly thin-winged with wings 0.6–1.1 mm wide, the margin finely serrulate except near base, rarely erose, scalloped, or with an irregular tooth in the shoulder area, abruptly contracted into a narrow beak, the area around the achene and beak base light green, yellow-brown, or pale reddish brown, wing margin greenish or pale brown, 0 to 3(5) nerves adaxially over achene, 0 to 8 nerves abaxially over achene and 1 or 2 nerves in winged margin; beaks 1.7–2.6(–2.8) mm long, strongly flattened and serrulate-margined to apex, the dorsal suture pale or reddish brown, the apex conspicuously bidentate with scabrous-margined teeth 0.1–0.6 mm long, distance from summit of achene to tip of beak 2.6–4.2 mm long. Achenes 1.6–2.2 × 1.2–1.6 mm, 1.2–1.7 times as long as wide, biconvex, elliptical to ± orbicular, pale to dark brown, short-stipitate at base, apiculum 0.4–1.1 mm long; style straight; stigmas 2. Anthers 3, 2.2–3.6 mm long. Chromosome number: n = 23 II + 1 III, 24 II + 1 III, 24 II + 2 III, 25 II, 25 II + 1 III, 26 II, 27 II.

For a species of narrow geographic distribution and habitat range, the chromosome numbers for *Carex missouriensis* were remarkably variable (Table 1). Chromosomes ranged from n = 23 II + 1 III to n = 27 II, with more than half of the plants sampled having at least one trivalent in the chromosome complement. In spite of the wide range in chromosome numbers, both *C. opaca* and *C. shinnersii* had distinctly higher numbers.

Carex missouriensis inhabits prairie swales, often on bottomlands. Many collections come from narrow remnant prairie communities extant along railroad right-of-ways. Despite this limitation, populations were frequent from central Illinois to northeastern Missouri, but extend to southeastern Kansas, southeastern Nebraska, and southern Iowa (Fig. 10). Efforts to find populations in extreme eastern Illinois were unsuccessful. A single historical collection exists from western Indiana. Field reconnaissance identified the likely location but habitat disturbance and/or competition with *Phalaris arundinacea* L. have probably extirpated the population.

Carex missouriensis is named for the fact that Missouri is the heart of the species range. The name *Carex meadii* is already occupied, so it was

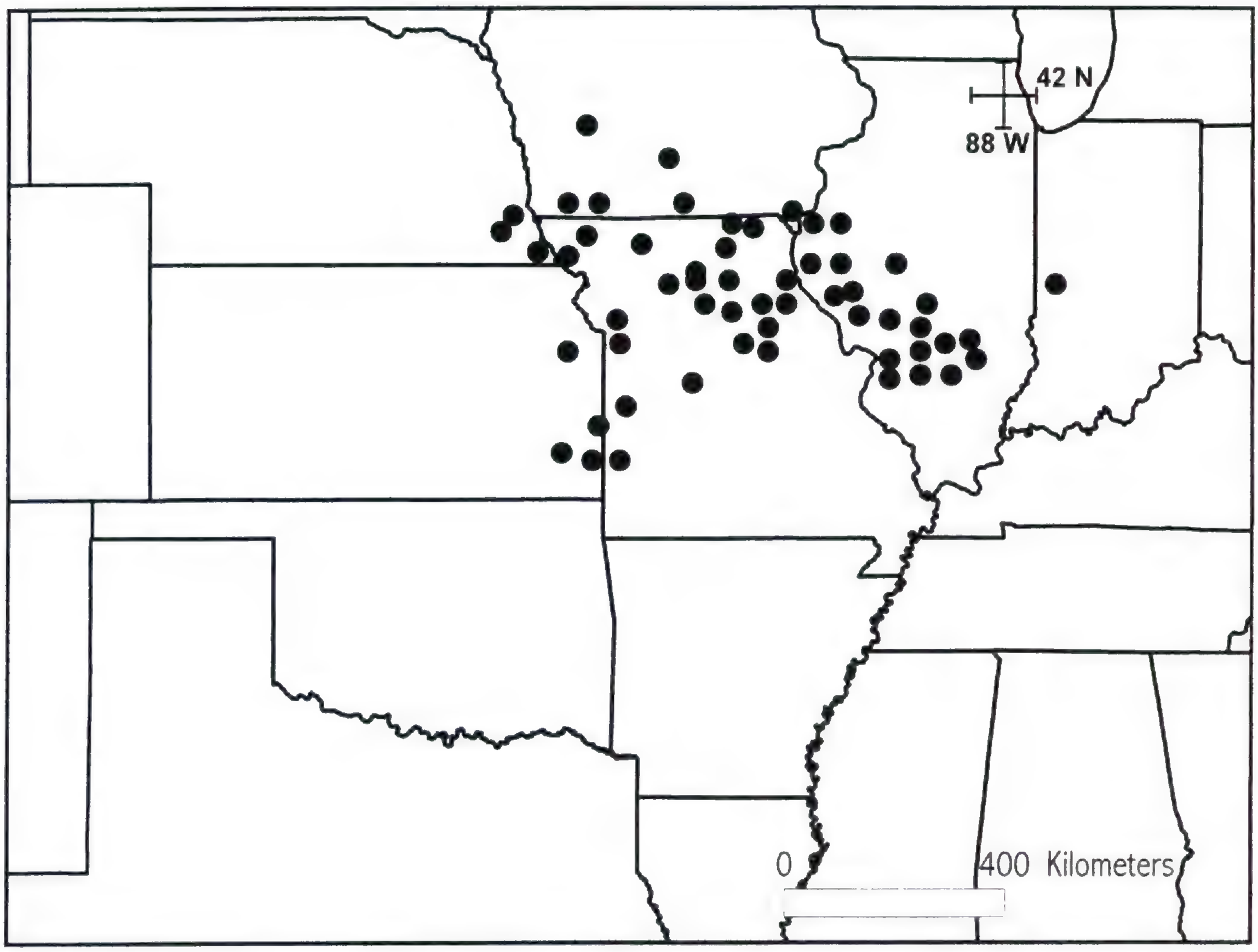


Figure 10. Geographical distribution of *Carex missouriensis*.

not possible to raise *C. straminea* var. *meadii* Boott to species rank. However, Boott (1862) first noted and illustrated the distinctive scales of this plant, commenting that "the long cuspidation of the squamae, with their broad, hyaline margins, give a peculiar aspect to this form." Boott cited two syntypes for this variety: Illinois, *Dr. Short, Dr. Mead.* Both syntypes are extant in Boott's herbarium (K), and we select the Mead specimen as lectotype because it was used for Boott's illustration. The sheet in Boott's herbarium had no data besides Illinois. A possible isolectotype with the additional data "Augusta, 1842" is in US, and additional possible isolectotypes with the data "Augusta, 9 May 1842" are in GH and F.

This species clearly has been a puzzle to Missouri botanists for a long time, as notes on herbarium sheets by D. Castaner and J. A. Steyermark, and annotations by F. J. Hermann clearly indicated the unusual morphology of some Missouri specimens they called *C. bicknellii.* Yatskievych (1999) also clearly outlined the three elements of the *C. bicknellii* complex in Missouri. The Menard County record for *C. straminea* in Illinois (Mohlenbrock, 1999) is based on a specimen of *C. missouriensis.*

Putative hybrids with other species: none known.

Paratypes. U.S.A. **Illinois:** Adams Co., 1 mi. NE of La Prairie, *R. A. Evers 63662* (ILLS); Bond Co., SW of Mulberry Grove, *R. A. Evers 23885* (ILLS); Brown Co., along RR, W of Timewell, *R. A. Evers 108195* (ILLS); Clinton Co., ca. 0.25 mi. E of 800E, ca. 0.75 mi. W of Breese, *P. E. Rothrock 3569* (MICH); Effingham Co., S of Montrose, *R. A. Evers 16440, 16444* (ILLS); Fayette Co., W of St. Elmo, *R. A. Evers 10125* (ILLS); along RR, N of Ramsey, *R. A. Evers 68813* (ILLS); Greene Co., 5 mi. N of Eldred, *R. A. Evers 33270* (ILLS); Hancock Co., along Wabash RR, Denver, *F. C. Gates 8823* (F); Madison Co., W side of Ill. 111, N of Poag Rd., *E. F. Ulaszek 1337* (ILLS); Marion Co., along RR, NE of Kinmundy, *R. A. Evers 112926A* (ILLS); McDonough Co., along RR, E of Tennessee, *R. A. Evers 72803* (ILLS); Menard Co., Athens, June 1870, *E. Hall s.n.* (F, GH, NY); Montgomery Co., 7.9 mi. NE of the middle of Irving, *A. A. Reznicek et al. 10207* (F, GH, ILLS, KANU, MICH, MO, NY); Pike Co., along GM&O RR, W of Pleasant Hill, *R. A. Evers 107822* (ILLS); St. Clair Co., W of Caseyville, *J. O Neill 3179* (ILLS); Scott Co., SE side of State Rte. 267, 0.3 mi. SW of Scott-Morgan Co. line, ca. 1.5 mi. NE of Manchester, *A. A. Reznicek et al. 10219* (ILLS, MICH, MO, WIS). **Indiana:** Parke Co., 5 mi. NE of Clinton, *R. M. Kriebel 10198* (PUL). **Iowa:** Lee Co., Keokuk, 1 June 1897, *B. Shimek s.n.* (ISC); Page Co., along Waubash Trace railway in Sec. 16, Colfax Twp., *B. Wilson 2671* (OMA); Warren Co., Middle River, 31 May 1919, *L. H. Pammel s.n.* (ISC).

Kansas: Bourbon Co., 1/2 mi. S of Hammond, *D. Castaner 3479* (MO); Crawford Co., Arma, *A. A. Reznicek et al. 9821* (BRCH, KANU, KNK, MICH); Douglas Co., 3 mi. E of Lawrence, *L. J. Harms 1258* (GH, KANU, NY); Johnson Co., 2 mi. W Clearview City, S side jct. of KS Hwy. 10 and Evening Star Road, *C. Morse 4561A* (KANU, MICH); Linn Co., floodplain of Marais de Cygne River, 2 mi. W, 1.5 mi. N of La Cygne, *L. J. Harms & O. A. Kolstad 2017* (KANU); Neosho Co., US Hwy. 59 ca. 3 mi. N of Parsons, 0.4 mi. N of Neosho Co. line, *A. A. Reznicek et al. 9833* (BRCH, Hb. C. T. Bryson, KANU, KNK, MICH). **Missouri:** Adair Co., 0.2 mi. SE of jct. with Rte. KK in Millard, *A. A. & S. A. Reznicek 9859* (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, VPI); Audrain Co., low area between Hwy. 22 and Boone Co. Line Road, *D. Castaner 7570* (MICH, MO, WIS); 1.5 mi. E of jct. with Rte. V to Sturgeon, *A. A. & S. A. Reznicek 9864* (BRCH, FTG, MICH, MO); Barton Co., along Pettis Creek, 4 mi. S of Lamar, *E. J. Palmer 65082* (KANU, WIS); Benton Co., 2.25 mi. S of Pettis Co., 5 mi. E of 65, 3.5 mi. W of Lake Creek (town), *D. Castaner 6293* (MO); Boone Co., ca. 5 mi. NNW of Centralia, *A. A. & S. A. Reznicek 9867* (FTG, MICH, MO); 2 mi. E of Sturgeon, *D. Castaner 7562* (MO); Callaway Co., Tucker Prairie, ca. 2.5 mi. WNW of jct. US 54 and I-70 in Kingdom City, *A. A. Reznicek et al. 10192* (F, KNK, MICH, MO, WIS); Clay Co., N of Kansas City along Bedford at Quebec Street along RR, *D. Castaner 10357* (MO); Gentry Co., W of Stanberry on Hwy. 136, *D. Castaner with G. Maupin 5678* (MO); Harrison Co., E of 00 (Bethany), S of 136 at Dept. of Conservation prairie, *D. Castaner et al. 5711* (MO); Holt Co., Squaw Creek National Wildlife Refuge, *P. M. McKenzie 1378* (MICH, MO); Jackson Co., Grain Valley, *B. F. Bush 7000* (F, GH, MO); Linn Co., 4 mi. S of North Salem, *J. A. Steyermark 65647* (F); Livingston Co., 7 mi. S of Trenton, *B. Summers with K. Kramer 4346* (MO); Macon Co., 0.4 mi. W of the Chariton River bridge, ca. 12 mi. W of Macon, *A. A. & S. A. Reznicek 9856* (BRCH, Hb. C. T. Bryson, DAO, FTG, GENT, KNK, MICH, MO, TRTE, VDB, VPI); Marion Co., 1.7 mi. E of Rte. V jct. at Hunnewell, *A. A. & S. A. Reznicek 9873* (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Monroe Co., 0.6 mi. N of Monroe Co. line, ca. 10 mi. N of Centralia, *A. A. & S. A. Reznicek 9869* (BRCH, MICH, MO); Nodaway Co., ca. 4.0 km N of Pickering on E side of St. Hwy. 148, *G. Yatskievych with B. Summers 93-178* (MICH, MO); Ralls Co., 2.2 mi. W of jct. Rte. J to Perry, ca. 2 mi. NE of Monroe City, *A. A. & S. A. Reznicek 9876* (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO); Randolph Co., US Hwy. 63, 0.4 mi. S of jct. with Rte. J in Jacksonville, *A. A. & S. A. Reznicek 9863* (BRCH, Hb. C. T. Bryson, KNK, MICH, MO); Schuyler Co., E side of RR tracks along SR 202, 1 mi. N of jct. with CR AA at Glenwood, *P. E. Rothrock 3558* (MICH, MO); Shelby Co., US Hwy. 36, 2.4 mi. WNW of jct. with Rts. T and PP at Lakenan, *A. A. & S. A. Reznicek 9871* (BRCH, FTG, KNK, MICH, MO). **Nebraska:** Johnson Co., Middle Branch Big Nemaha River, 2 mi. S, 1.4 mi. E of St. Mary, *S. Rolfsmeier et al. 8689* (NEB); Otoe Co., near Palmyra, *W. Kiener 30008* (NEB); Richardson Co., right-of-way of CB&Q RR about 1 mi. SE of Salem depot, *P. Shildneck C-6474* (ILLS, KANU, MOR, NEB).

4. **Carex opaca** (F. J. Hermann) P. Rothrock & Reznicek, comb. et stat. nov. Basionym: *Carex bicknellii* var. *opaca* F. J. Hermann, Sida 5: 49. 1972. TYPE: U.S.A. Arkansas: Prairie Co., river terraces, never plowed, rice region, Hazen, elev. 215′, 10 May 1969, *D. Demaree 60141* (holotype, US; isotypes, BRIT, MO).

Caespitose in dense, large clumps of up to 200 culms from short, thick, woody rhizomes; fertile culms 50–115 cm tall, erect, trigonous, finely scabrous-angled below inflorescence; bladeless basal sheaths medium to dark brown, disintegrating into short, dark brown fibers. Leaves 3 to 6, on the lower 1/4–2/5(–1/2) of the culm; blades 3.5–40 cm long, 1.5–4.6 mm wide, plicate, glabrous, the margins, midrib, and sometimes the adaxial leaf surface antrorsely scabrous distally; leaf sheaths ca. 3–12 cm long, tightly enveloping culms, smooth, green, larger sheaths with the intervenal areas pale whitish green with scattered, ± horizontal green septae on the upper portion; the inner band of sheaths glabrous, green with a whitish-hyaline band near the apex, the apex concave to truncate, ± equaling the base of the blade, whitish-hyaline, sometimes brown-tinged; ligules 1.5–5.4 mm long, rounded to obtuse, the free portion entire and up to 0.8 mm long. Vegetative culms annual, few, fully developed only after perigynia are largely shed, ca. 35–80 cm tall with ca. 6 to 14 leaves mostly clustered near the summit of the culm. Inflorescences 2.4–5.5(–6.4) cm long, erect to slightly arching, the spikes overlapping or the lowermost separate, the lowest spikes 4–13(–18) mm apart, spikes single at nodes, sessile; lowermost bracts scalelike, 0.5–1.5 cm long, inconspicuous, sheathless, upper bracts much reduced; spikes 4 to 8(10), gynecandrous, ovoid with rounded to tapered bases, 10–22 mm long, pistillate portion 9–14 × 5.5–12 mm, ca. 15- to 40-flowered, staminate portion 1–8(–14) × 1.5–2.6 mm, ca. 7- to 18-flowered. Pistillate scales (3.6–) 3.9–5 × 1.3–1.9 mm, not or barely reaching the base of the beak, usually 1.5–2.6 mm shorter than the perigynia, (2.2–)2.4–3.2(–3.4) times as long as wide, lanceolate to narrowly ovate, obtuse to acute, rarely the uppermost acuminate, pale brown with narrow yellow-green to brown center and narrow hyaline margins, 1-nerved, the nerve reaching to the apex. Staminate scales 3.6–5.2 × 1.5–2.4 mm, narrowly ovate to narrowly elliptic, obtuse to acute, pale brown with narrow hyaline margins, 1-nerved. Perigynia glabrous, sessile, (5–)5.8–7.1 × (3.1–) 3.3–4.6(–4.8) mm, 1.3–1.9 times as long as wide, ± appressed and often strongly concave, 0.5–0.7 mm thick, herbaceous, opaque over achene; bodies broadly ovate, broadly elliptic, or orbicular (3.2–) 3.9–5 mm long, (0.8–)1–1.4 times as long as wide, 1.9–3 times as long as the beak, and widest (1.4–) 1.8–2.8 mm above base, broadly thin-winged with wings 0.9–1.6 mm wide, finely serrulate-margined above the middle, contracted into a beak, yellowish green to brown with paler margins, ± clearly 3- to 7-nerved adaxially over the achene, 8- to 12-nerved

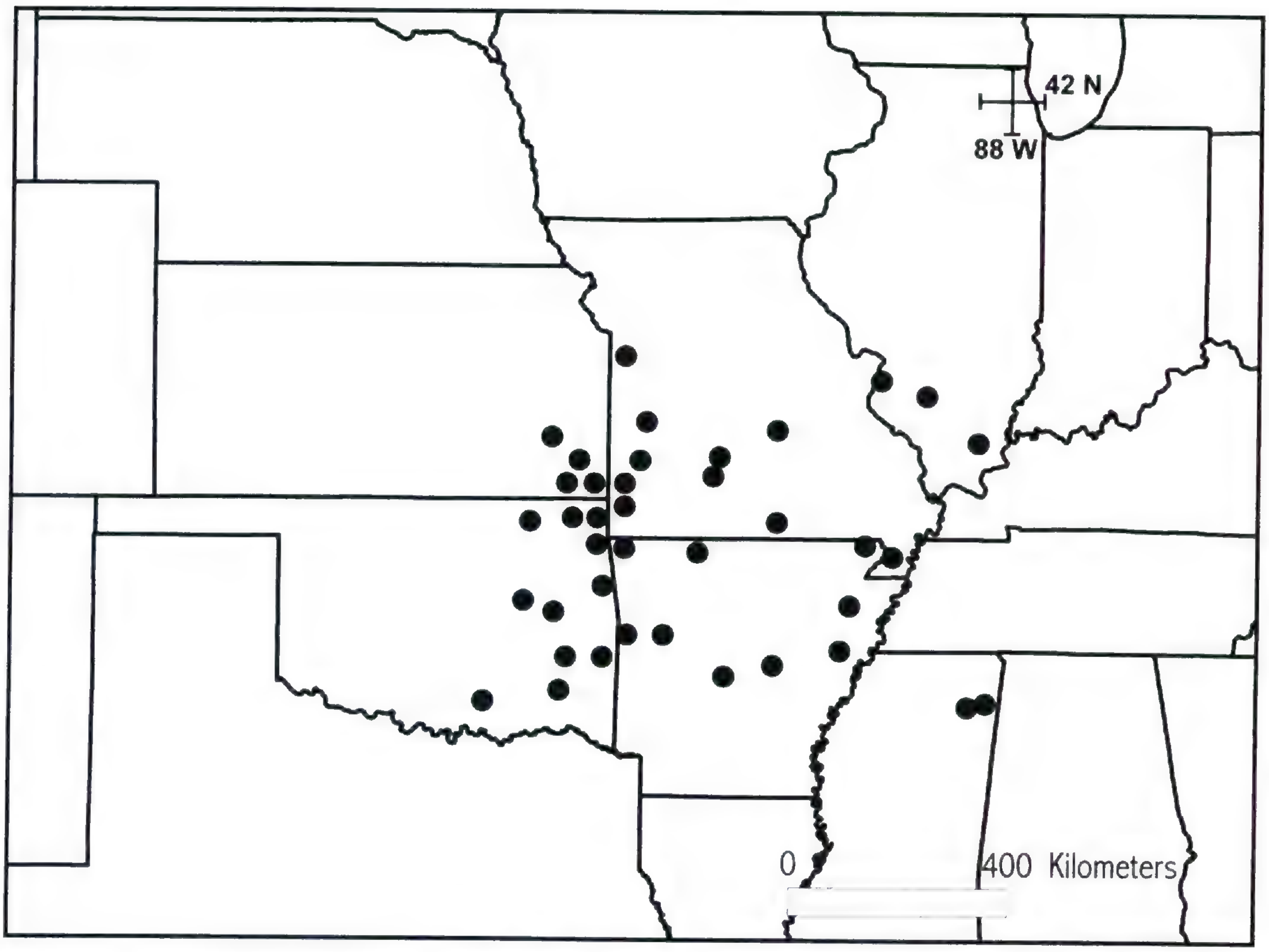


Figure 11. Geographical distribution of *Carex opaca*.

abaxially over the achene and 2- to 5-nerved in the wings; beaks (1.2–)1.5–2.3 mm long, strongly flattened and serrulate-margined to apex, the apex bidentate with scabrous-margined teeth 0.2–0.5 mm long, distance from summit of achene to tip of beak 2.8–4 mm. Achenes 1.8–2.4 × 1.3–1.9 mm, 1.1–1.6 times as long as wide, biconvex, broadly ovate to oblong, pale brown to brown, short-stipitate at base, apiculum 0.5–1.1 mm long; style straight; stigmas 2. Anthers 3, 2.2–3.4 mm long. Chromosome number: n = 32 II + 1 III, 33 II, 34 II.

Carex opaca had chromosome numbers ranging from n = 32 II + 1 III to n = 34 II (Table 1). This range is higher than that of *C. shinnersii* and very much higher than that of *C. missouriensis*, thus providing strong cytogenetic support for recognizing *C. opaca* as a distinct species.

Carex opaca occupies wet areas in regions where the presettlement vegetation included prairie and savanna. The type locality is described by Demaree as low areas in "rice prairies." *Carex opaca* is still present in moist sites in extant prairies and savannas, but compared to *C. missouriensis*, it tolerates or is quick to invade disturbance sites and may be associated with poorly drained areas along highway right-of-ways. In spite of this tolerance of disturbance, the geographical distribution of *C. opaca* is surprisingly narrow. When first described as *Carex bicknellii* var. *opaca*, it was thought to be an Arkansas endemic. Later, it was reported for Missouri and Oklahoma by Castaner (1989). The species center of distribution surrounds the Ozark Mountain system (Fig. 11). Somewhat disjunct populations occur in southernmost Illinois. Roadside occurrences in Mississippi and perhaps other roadside occurrences at the periphery of the species range may be recent introductions.

Putative hybrids with other species: none known.

Representative specimens. U.S.A. **Arkansas:** Benton Co., S side I-412, 0.2 mi. W of Ark. Hwy. 16B jct., E outskirts of Siloam Springs, *A. A. Reznicek et al. 9788* (BRCH, MICH, UARK); Boone Co., S of Harrison, *P. E. Hyatt 3857.05* (MICH); Clay Co., 4.5 mi. E of Ark. Hwy. 135 on US Hwy. 62, *P. E. Hyatt 4380.11* (MICH); Logan Co., W side Ark. Hwy. 23, 5 mi. NE of Franklin Co. line, 0.8 mi. SW of Caulksville, *A. A. Reznicek et al. 9387* (Hb. C. T. Bryson, MICH, TAES, UARK); Lonoke Co., NE corner of interchange I-40 and Ark. Hwy. 13, just N of Carlisle, *A. A. Reznicek et al. 9265* (Hb. C. T. Bryson, FTG, GENT, KNK, MICH, TAES, UARK, VDB, VPI); Poinsett Co., Waldenberg P.O. property, *P. E. Hyatt 4350.56* (MICH); Prairie Co., Ulm, *D. Demaree 14915* (BRIT, ISC,

MICH, MO, OS, WIS); Saline Co., low, moist bottoms, Benton, *D. Demaree 22969* (GH, IND); St. Francis Co., Rock Island (So. Pacific) RR Prairie, N side of US 70, *A. B. Pittman 303* (MICH); Sebastian Co., 5.8 mi. W of Bloomer, *L. H. Shinners 19831* (BRIT); county unknown, low ground, NW Ark., May 1884, *F. L. Harvey 10, 14* (F, GH, US). **Illinois:** St. Clair Co., E of Fayetteville, *R. A. Evers 73553* (ILLS); Saline Co., Harrisburg, 0.2 mi. N of US Rt. 45, 0.3 mi. SW of Middle Fork of the Saline River, *S. R. Hill 32379 with K. Haefner* (ILLS, MICH); Washington Co., railroad trackway at Venedy Station, *R. A. Evers 33943* (ILLS). **Kansas:** Cherokee Co., W side US Hwy. 69, ca. 6 mi. S of Pittsburg, 1.1 mi. S of Cherokee/Crawford Co. line, *A. A. Reznicek et al. 9824* (BRCH, Hb. C. T. Bryson, KANU, MICH); Crawford Co., 3 mi. E, 3 mi. S of Pittsburg, *O. A. Kolstad & L. J. Harms 2264* (GH, KANU); Labette Co., N side of US Hwy. 160, 1.3 mi. E of Neosho River bridge, ca. 10 mi. E of Parsons, *A. A. Reznicek et al. 9830* (BRCH, KANU, MICH); Neosho Co., K57, W edge of St. Paul, *O. A. Kolstad & L. J. Harms 2282* (BRIT, KANU); Neosho County State Lake, *R. L. McGregor 38183* (KANU). **Mississippi:** Itawamba Co., N of Dorsey, SW jct. of hwy. 78 and Fawn Grove/Dorsey exit, *C. T. Bryson 13802* (Hb. C. T. Bryson, MICH); Lee Co., E of Tupelo, jct. hwy. US 78 and Auburn Rd., *C. T. Bryson 12400* (Hb. C. T. Bryson, MICH). **Missouri:** Barton Co., Cook Meadow, 2 mi. NW of Golden City on S side of Co. Hwy. U, *G. Yatskievych et al. 94-119* (MO); Howell Co., Warden Prairie, ca. 4 mi. SW of West Plains, ca. 1/2 mi. S of jct. w/ US 160, *G. Yatskievych et al. 92-192* (MO); Jasper Co., Wah-Sha-She Prairie Conservation Area, ca. 2 mi. N of Ashbury, *A. A. Reznicek et al. 9803* (BRCH, Hb. C. T. Bryson, KNK, MICH); Laclede Co., 2 1/2 mi. N of Phillipsburg, *B. Summers 4434* (MO); Newton Co., along creek, Seneca, *E. J. Palmer 65452* (GA); Phelps Co., 10 mi. SE of Rolla, 2 mi. SW of Elk Prairie, *J. A. Steyermark 71641* (F, MO); St. Clair Co., near Taberville Prairie, 7 June 1977, *A. Christ s.n.* (MO); Stoddard Co., S side of US Hwy. 60, 1.4 mi. W of jct. with County Rd. TT at Dudley, *A. A. Reznicek et al. 9421* (Hb. C. T. Bryson, KNK, MICH, MO, TAES, VDB); Vernon Co., N side of MO Hwy. 54, 1.1 mi. E of jct. MO Hwy. 43, ca. 3 mi. W of Nevada, *A. A. Reznicek et al. 9820* (BRCH, Hb. C. T. Bryson, FTG, KNK, MICH, MO, VPI); Webster Co., S side of Hwy. US 60 along the St. Louis–San Francisco RR, *A. E. Brant & R. E. Gereau 556* (SIU). **Oklahoma:** Adair Co., 1 mi. S and 5 mi. W of Watts, *U. T. Waterfall 7013* (BRIT); Craig Co., US 66, 3.3 mi. W of Delaware Co. line, *M. Huft & M. Goodman 1103* (OKL); Delaware Co., 6 mi. E of Hwy. 10 on Hwy. 20 from Jay, *D. Castaner 7470* (MICH, MO, WIS); Johnston Co., 0.4 mi. E on OK 7 from its jct. with the Blue River, E of Reagan, *S. & G. Jones 10230* (MICH); Latimer Co., N side US Hwy. 270, 3.2 mi. E of center of Wilberton, 4.1 mi. E of jct. Hwy. 2S and US Hwy. 270, *A. A. Reznicek et al. 9341* (Hb. C. T. Bryson, MICH, TAES); Le Flore Co., W side Okla. Hwy. 120, 3.7 mi. W of Cameron, *A. A. Reznicek et al. 9330* (Hb. C. T. Bryson, KNK, MICH, TAES); McIntosh Co., 1/2 mi. N of Checotah, *D. Castaner 1200* (MO); Okmulgee Co., Deep Fork Unit, Eufaula WMA, *B. Hoagland & E. Wagoner DF0013* (OKL); Ottawa Co., ½ mi. NE of Quapaw on US 66, *C. S. Wallis 7273* (BRIT, KANU, NCU, OKL); Pushmataha Co., E side Okla. Hwy. 2, 3.5 mi. S of Latimer Co. line, 0.5 mi. N of jct. with US 271N, ca. 19 mi. S of Wilberton, *A. A. Reznicek et al. 9344* (Hb. C. T. Bryson, MICH, TAES); Washington Co., about 1/4 mi. S of Copan dam on Caney River, *J. & C. Taylor 33290* (BRIT).

5. Carex shinnersii P. Rothrock & Reznicek, sp. nov. TYPE: U.S.A. Texas: Delta Co., W side Texas Hwy. 19, 1.9 mi. S of jct. with Texas Hwy. 24, ca. 7 mi. NE of Cooper, 33°25′51″N, 95°36′11″W, wet, seasonally flooded grassy ditch, abundant in large, dense clumps around the edges of the lowest and wettest depressions in the ditch that were essentially free of vegetation due to flooding, 3 May 1997, *A. A. Reznicek 10367 with S. D. Jones & S. A. Reznicek* (holotype, MICH; isotypes, BH, BRCH, BRIT/SMU, Hb. Charles T. Bryson, F, GENT, GH, K, KANU, KNK, KSC, MO, NY, OKL, TENN, TEX, UARK, US, VDB, WIS).

Caespitosae; culmi fertiles 40–110 cm alti; vaginae basales brunneae. Folia 4–6; laminae 2.5–35 cm longae, 1.8–4.2 mm latae; vaginae ca. 2–11 cm longae, ventraliter herbaceae, laeves. Culmi vegetativi erecti, annui. Inflorescentiae 2.8–5.9 cm longae, erectae, plus minusve congestae; spicae (3–)4–7(–11) gynaecandrae, ovoideae, 9.5–20.5 × 8–11.5 mm, basi staminata (1.5–)2–9.5 mm longa. Squamae pistillatae pallide brunneae, acuminatae. Perigynia (4.5–)4.8–6.1(–6.3) × 2.5–3.8 mm, ascendentia, corporibus ellipticis, ovatis, vel rotundis, in rostrum serrulatum 1.4–2.2 mm longum contracta. Achenium 1.8–2.4 × 1.3–1.7 mm, biconvexum. Stigmata 2. Antherae 3, 2.4–3.4 mm longae.

Caespitose in dense, large clumps of up to 200 culms from short, thick, woody rhizomes; fertile culms 40–110 cm tall, erect, trigonous, smooth to finely scabrous-angled below inflorescence; bladeless basal sheaths medium to dark brown, disintegrating into short, dark brown fibers. Leaves 4 to 6, on the lower (1/4–)3/10–1/2 of the culm; blades 2.5–35 cm long, 1.8–4.2 mm wide, plicate, glabrous, the margins and midrib antrorsely scabrous distally; leaf sheaths ca. 2–11 cm long, tightly enveloping culms, smooth, green, larger sheaths with the intervenal areas pale whitish green with scattered, ± horizontal green septae; the inner band of sheaths glabrous, green with a broad whitish-hyaline band, the apex concave to truncate, equaling to extending 2 mm above the base of the blade, whitish-hyaline, sometimes brown-tinged; ligules 1.8–4.8 mm long, rounded to obtuse, the free portion entire and up to 0.6 mm long. Vegetative culms annual, few, fully developed only after perigynia are largely shed, ca. 30–90 cm long with ca. 9 to 17 leaves mostly clustered near the summit of the culm. Inflorescences 2.8–5.9 cm long, erect to slightly arching, the spikes overlapping to somewhat distant, the lowest spikes 3.5–12(–17) mm apart, spikes single at nodes, sessile, lowermost bracts scalelike to setaceous with an expanded base, 0.5–1.5(–3.5) cm long, inconspicuous, sheathless, upper bracts much reduced; spikes (3–) 4–7(–

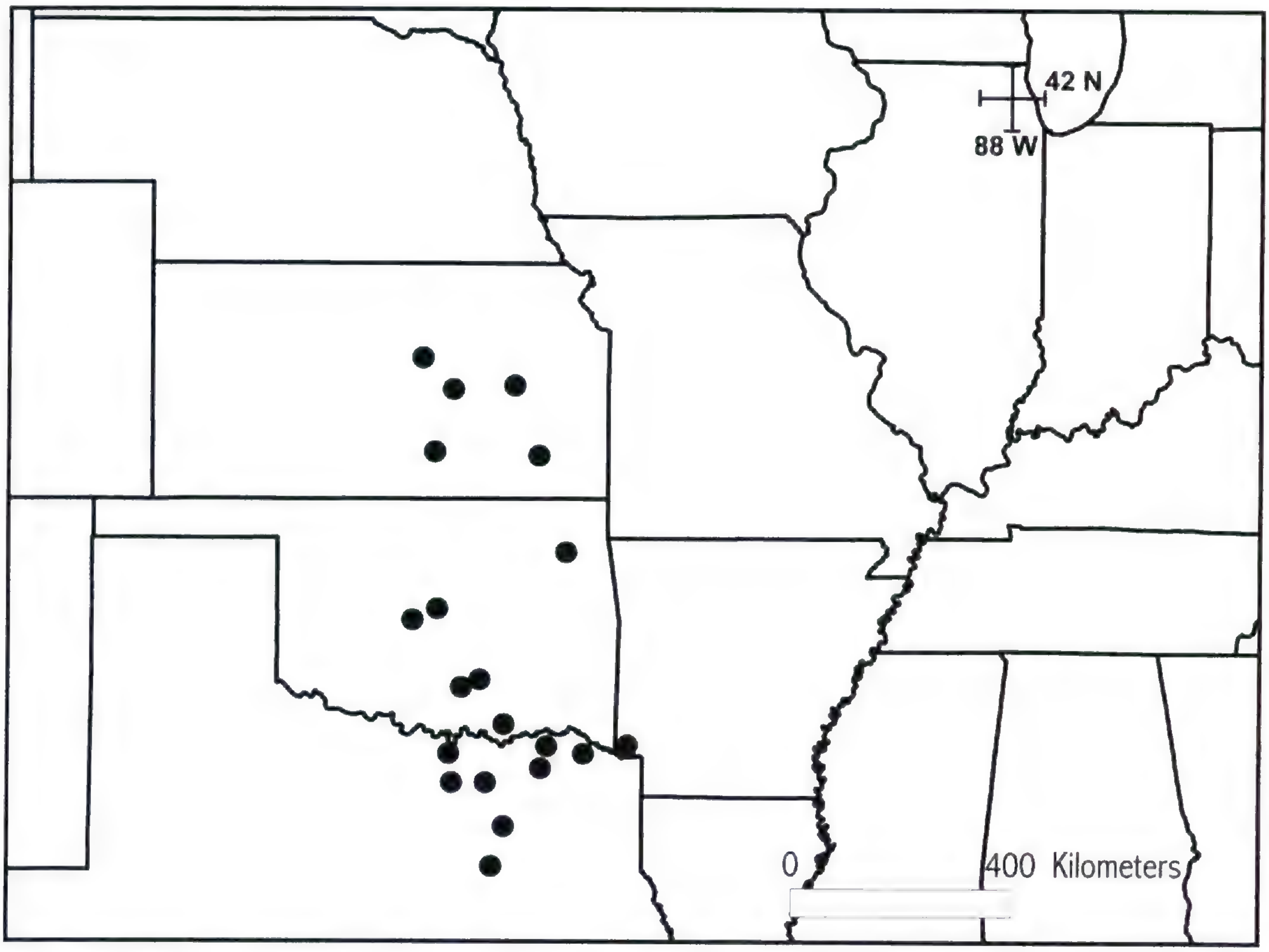


Figure 12. Geographical distribution of *Carex shinnersii*.

11), gynecandrous, ovoid with ± tapered bases, 9.5–20.5 mm long, pistillate portion 7–12 × 8–11.5 mm, ca. 18- to 45-flowered, staminate portion (1.5–)2–9.5 × 1.2–2 mm, ca. 12- to 20-flowered. Pistillate scales (3.7–)4–5.2 × 1.1–1.6(–1.8) mm wide, reaching the base to the middle of the beak, (0.4–)0.6–1.4(–1.6) mm shorter than the perigynium, (2.6–)2.9–3.7(–4.2) times as long as wide, lanceolate, acuminate, pale brown with narrow yellow-green to brown center and narrow hyaline margins, 1-nerved, the nerve extending to the scale apex. Staminate scales 3.9–5.6 × 1.2–1.8 mm, narrowly ovate to narrowly elliptic, acute to acuminate, pale brown with hyaline margins, 1-nerved. Perigynia (4.5–)4.8–6.1(–6.3) × 2.5–3.8 mm, 1.4–2.3 times as long as wide, glabrous, sessile, ascending, planoconvex, 0.5–0.7 mm thick, herbaceous, opaque over achene; bodies ovate, elliptic, or ± orbicular, (2.8–)3.3–4.4 mm long, 1–1.6 times as long as wide, 1.8–2.6(–3) times as long as the beak, and widest 1.6–2.9 mm above base, broadly thin-winged with wings 0.5–1.3 mm wide, finely serrulate-margined except near base, contracted into a beak, yellowish green to brown with paler margins, faintly (0)2- to 8-nerved adaxially over the achene, 7- to 11-nerved abaxially over the achene and 1- to 4-nerved in the wings; beaks 1.4–2.2 mm long, strongly flattened and serrulate-margined to apex, the apex bidentate with scabrous-margined teeth 0.1–0.5 mm long, distance from summit of achene to tip of beak (2–)2.3–3.3 mm. Achenes 1.8–2.4 × 1.3–1.7 mm, (1.2–)1.4–1.6 times as long as wide, biconvex, ovate to elliptic, pale brown to brown, short-stipitate at base, apiculum 0.4–0.9 mm long; style straight; stigmas 2. Anthers 3, 2.4–3.4 mm long. Chromosome number: $n = 29$ II + 1 III, 30 II.

Carex shinnersii appears to range along a narrow band that extends from northeastern Texas to south-central Kansas (Fig. 12). It occupies moist to wet depressions in prairies, wet habitats along stream bottoms, in either open or lightly shaded settings, as well as similar man-made habitats such as ditches, shores of ponds and reservoirs, etc.

The epithet *shinnersii* honors Lloyd H. Shinners, keen and perceptive student of the Texas flora. Shinners first recognized this species as different from anything else known from Texas, outlined the differences in brief notes on herbarium sheets, and reported it as *Carex bicknellii* (Shinners, 1958).

At its large and small extremes, *Carex shinnersii* is similar to *C. opaca* and *C. brevior,* respectively, and can be difficult to distinguish, especially in poorer herbarium specimens, where the diagnostic pistillate scale apices can be mostly tattered or broken.

A site in Kaufman County, Texas, supported a population of *Carex shinnersii* growing with *C. brevior* and *C. tetrastachya* in the vicinity. In this setting, plants assignable to *C. shinnersii* had two possible chromosomal conditions. The collection *Reznicek 10347* displayed normal meiotic condition and had $n = 30$ II (Table 1). Two plants (from the population represented by *Reznicek 10346* (BRCH, BRIT, MICH, MO)) had disturbed meiotic pairing that we interpret as $n = 18$ II + 1 IV + 4 III. Although meiosis is irregular, their achenes appear fertile, becoming plump and starch filled. It is possible that these individuals are a hybridization product with *C. brevior.* This conclusion is supported by the number of chromosome components being intermediate in number between local *C. brevior* (with variable numbers: $n = 24$ II, 24 II + 1 IV, and 26 II; Rothrock & Reznicek, 1998) and typical *C. shinnersii.* Furthermore, perigynia were at the low end of the size range characteristic of *C. shinnersii* and the pistillate scales were less acuminate than seen in *Reznicek 10347.* None of these observations support hybridization with *C. tetrastachya.*

Paratypes. U.S.A. **Arkansas:** Little River Co., Foreman, 5 mi. S on Ark. Hwy. 41, extreme NW/4 of Sec. 14, T13S, R32W, *P. E. Hyatt 7441* (MICH, UARK), *7442* (MICH, MO). **Kansas:** Chase Co., 2.0 mi. E Saffordville on US 50, NW corner of jct. 100 Rd. and Hwy. 50, *C. A. Morse 3449 & D. S. Baker* (DAO, F, GH, K, KANU, KSC, MICH, MO, NY, US, WIN); Lyon Co., 3.05 mi. E Saffordville on US Hwy. 50, *C. A. Morse 3447 & D. S. Baker* (BRIT, Hb. C. T. Bryson, KANU, KSC, MICH, MO, OKLA); Marion Co., 3.1 mi. N, 3.0 mi. E Hillsboro, W side of Marion Reservoir, *C. A. Morse 3450 & D. S. Baker* (KANU, MICH, MO, NEB, OKL); Saline Co., 1 mi. W of Gypsum, *R. E. Brooks 17138* (KANU, GA); Sedgwick Co., ¼ mi. NE of Viola, *S. Stephens 84776* (KANU); Wilson Co., 1 mi. S, 0.5 mi. E of Buffalo, *R. L. McGregor 38265* (KANU). **Oklahoma:** Bryan Co., Blue River bridge on #69 N of Armstrong, *D. Castaner 1548* (BRIT); Garfield Co., 1½ mi. S of Covington, *S. Stephens 76721* (KANU); Mays Co., W side Okla. Hwy. 69, 5.4 mi. N of Adair (at Hwy. 28 Jct.), *A. A. Reznicek 9764 et al.* (BRCH, MICH, OKL); Murray Co., E of Breezy Point, *F. L. Johnson et al. 30* (OKL); Oklahoma Co., 3½ mi. N of Wheatland, *U. T. Waterfall 3639* (OKL); Pontotoc Co., Pontotoc Ridge Preserve (Smith Ranch), Sec. 32, T1N, R7E, *P. Folley 1197* (OKL). **Texas:** Collin Co., 3/7 mi. E of Farmersville, *L. H. Shinners 14319* (BRIT); Cooke Co., ca. 2 mi. NE of St. Jo on FM 2382 at the Cooke-Montague Co. line on S side of FM 2382, *E. L. Bridges & K. Kindscher 13661* (MICH); Delta Co., 0.1 of a mile S on FR 1529 from its jct. with Hwy. 154, *S. & G. Jones 2887 with T. Powell* (MICH); Denton Co., 10 mi. N of Denton, *V. L. Cory 57340* (BRIT); Kaufman Co., NE side of Co. Rd. 233 (Colquitt Rd.), 0.7 mi. NW of jct. with FR 1392, ca. 4 mi. NW of Terrell, *A. A. Reznicek 10347 et al.* (BRCH, BRIT, F, GH, KANU, KNK, MICH, MIN, MO, NY, OKL, TEX, US, VPI); Lamar Co., 5.2 mi. N on FR 1184 from its jct. with the extension of FR 1184 at Auds Creek, *S. G. Jones 2882 & T. Powell* (MICH); Navarro Co., Chambers Creek bottoms, 4½ mi. N of Corsicana, *V. L. Cory 51530* (BRIT, MICH).

Acknowledgments. We are grateful to the curators of all the herbaria who so kindly lent us material or accommodated our visits. We also thank the many people who accompanied us in the field during our studies of this group, and often helped us with finding localities in their home states or collecting more material for us, including Allison Cusick, Mike Homoya, Phil Hyatt, Brad Jacobs, Stanley and Gretchen Jones, Doug Ladd, Paul McKenzie, as well as George Yatskievych. Caleb Morse very kindly collected members of this complex for us in Kansas, and Paul McKenzie and Brad Jacobs collected the type of *Carex missouriensis* for us. Stuart Hay very kindly helped us track down, through the Montréal Botanical garden records, the identities of the plants used by N. Tanaka in his chromosome number papers. David Simpson helped greatly by searching for Boott types at K. Bev Walters took the SEM photo for Figure 1 and Susan Reznicek prepared Figure 3. We are also grateful to Paul McKenzie and George Yatskievych for their thorough and very helpful reviews of our manuscript. We could not have finished this project without their help.

Literature Cited

Boott, F. 1862. Illustrations of the Genus *Carex.* Part III. William Pamplin, London, pp. 105–126, pl. 311–411.

Castaner, D. 1989. Missouri *Carex* notes 4. *Carex bicknellii* var. *opaca* in Missouri. Missouriensis 10: 13–15.

Cooperrider, T. S. & J. H. Morrison. 1967. Lactic-acetic-orcein as a chromosome stain. Michigan Bot. 6: 176–178.

Farwell, O. A. 1923 [1924]. Notes on the Michigan flora Part V. Pap. Michigan Acad. Sci. 2: 11–46.

Fernald, M. L. 1902. The northeastern *Carices* of the section *Hyparrhenae.* Proc. Amer. Acad. Arts 37: 447–495.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. New York Botanical Garden, Bronx, 3 vols.

——— & A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd ed. New York Botanical Garden, Bronx.

Jones, S. D. & A. A. Reznicek. 1991. *Carex bicknellii,* "Bicknell's sedge" (Cyperaceae): New to Texas, with a key to Texas species of section *Ovales.* Phytologia 70: 115–118.

Hermann, F. J. 1972. A new variety of *Carex bicknellii* from Arkansas. Sida 5: 49.

Hill, S. R. & C. N. Horn. 1997. Additions to the flora of South Carolina. Castanea 62: 194–208.
Hyatt, P. E. 1998. Arkansas *Carex* (Cyperaceae): A briefly annotated list. Sida 18: 535–554.
Löve, A. & D. Löve. 1981. Chromosome number reports LXXIII. Taxon 30: 829–861.
Mackenzie, K. K. 1922 [1923]. Notes on *Carex*—XII. Bull. Torrey Bot. Club 49: 361–373.
———. 1931. Cariceae. N. Amer. Fl. 18: 1–168.
Mohlenbrock, R. H. 1999. The Illustrated Flora of Illinois. Sedges: *Carex*. Southern Illinois Univ. Press, Carbondale.
Reznicek, A. A. & P. E. Rothrock. 1997. *Carex molestiformis* (Cyperaceae), a new species of section *Ovales* from the Ozark Mountain region. Contr. Univ. Michigan Herb. 21: 299–308.
Rohlf, F. J. 1997. NTSYS-pc: Numerical Taxonomy and Multivariate Analysis System. Version 2.00. Exeter Software, Setauket, New York.
Rothrock, P. E. & A. A. Reznicek. 1996a. A new species of *Carex* section *Ovales* occurring in the Ozark Mountain region. Brittonia 48: 104–110.
——— & ———. 1996b. Chromosome numbers in *Carex* section *Ovales* (Cyperaceae) from eastern North America. Sida 17: 251–258.
——— & ———. 1998. Chromosome numbers in *Carex* section *Ovales* (Cyperaceae): Additions, variations, and corrections. Sida 18: 587–592.
Shinners, L. H. 1958. Spring Flora of the Dallas–Forth Worth Area, Texas. Published by the author, Dallas.
Tanaka, N. 1942. Chromosome studies in Cyperaceae. XX. Chromosome numbers of *Carex* (*Vignea*–II). Med. and Biol. 2: 220–224.
Yatskievych, G. 1999. Steyermark's Flora of Missouri, Vol. 1, Revised ed. Missouri Department of Conservation, Jefferson City, and Missouri Botanical Garden Press, St. Louis.

Hymenocallis (Amaryllidaceae) in Texas, with a New Varietal Combination

Gerald L. Smith

Biology Department, High Point University, University Station-Montlieu Avenue, High Point, North Carolina 27262-3598, U.S.A.

Walter S. Flory

Biology Department, Wake Forest University, Box 7325, Reynolda Station, Winston-Salem, North Carolina 27109-7325, U.S.A. [Deceased 8 June 1998.]

ABSTRACT. A review of the taxonomy of *Hymenocallis* in Texas since the publication of names by Lloyd H. Shinners is presented. The new varietal combination *H. occidentalis* (J. Le Conte) Kunth var. *eulae* (Shinners) G. Lom. Smith & Flory is made, recognizing leaf and cytological differences. A short key is provided to distinguish between the varieties.

Key words: Amaryllidaceae, *Hymenocallis*, North America, Texas, U.S.A.

Shinners (1951) recognized two species of *Hymenocallis* in Texas. He determined that the early-spring-blooming spider-lilies in east Texan wetlands represent the same species that Rafinesque (1817) described from Louisiana as *Pancratium liriosme*. Shinners transferred the species to *Hymenocallis* on the basis of its green, fleshy seeds, establishing *H. liriosme* (Rafinesque) Shinners. He further discussed the possibility that *H. galvestonensis* (Herbert) Baker is a synonym of *H. liriosme*, based on morphological similarities. Shinners also described a mid- to late-summer-blooming spider-lily, scattered in sandy, piney woods or in heavy soils near streams of east Texas as *H. eulae*. This epithet honored Eula Whitehouse, then a Technical Assistant in the herbarium of Southern Methodist University and artist-author of *Texas Flowers in Natural Colors* (Whitehouse, 1936). Correll and Johnston (1970) followed Shinners's taxonomy, as did Correll and Correll (1972), but they treated the more robust spring-blooming populations in inland counties of east Texas as *Hymenocallis caroliniana* (L.) Herbert.

Howard (1995) presented controversy with his determination that *Hymenocallis galvestonensis* (Herbert) Baker is the same species as *H. eulae* Shinners. His stated rationale was that the type collection (no date given) has no leaves. It is true that at the time of flowering, in mid summer, the leaves of *H. eulae* have senesced. However, we are convinced, for three reasons, that *H. galvestonensis*, originally described under *Choretis* by Herbert (1837), based on *Drummond 412* and later transferred to *Hymenocallis* by Baker (1888), is the same as *H. liriosme* (Rafinesque) Shinners. This species does not correspond to *H. eulae*.

First, the illustration (plate 41, fig. 34) accompanying Herbert's (1837) original description of *Choretis galvestonensis*, based on *Drummond 412*, shows an inflorescence that is a clear match for *Hymenocallis liriosme*. The staminal cup, perianth segments, free filaments, anthers, perianth tubes, and scape bracts, in both shape and dimension, represent the floral architecture of *H. liriosme*. In that species, the perianth segments, the tepal tubes, and the free filaments are decidedly shorter than those in *H. eulae*; the staminal cup has a prominent yellowish green eye and its margin is coarsely dentate to wavy. For *Hymenocallis eulae*, the staminal cup has a faint yellowish green eye and its margin is sharply dentate to lacerate. Moreover, in *Hymenocallis liriosme* the scape bracts are not distally long-acuminate but are so in *H. eulae*.

Second, Smith, during a week at MO in August 1992, made detailed measurements of over a thousand specimens of *Hymenocallis*, including the MO collection that incorporates the Traub specimens, many on loan from K and BM as well as American herbaria including SMU (now BRIT). Among the K and BM loans were specimens of *Drummond 412*, which without doubt correspond to *H. liriosme*.

Third, Herbert's type for *Choretis galvestonensis*, *Drummond 412*, was collected near Galveston Bay. Its numerous wetlands offer a prime habitat for *Hymenocallis liriosme*, and all other collections of *Hymenocallis* from Galveston County that have been examined are of *H. liriosme*. None are of *H. eulae*.

Certainly, it is puzzling that *Drummond 412* has

no leaves, as would be expected for *Hymenocallis liriosme* in bloom. Several reasons may be hypothesized for this situation. Drummond may have collected only the flowering scapes, or he may have made separate collections of the scapes and of the bulbs and leaves, which collectors frequently do with *Hymenocallis,* but for some reason, the bulbs and leaves were not associated with the scapes in his *412* collection. Alternatively, one can decide, as did Howard (1995), that *Drummond 412* is actually *H. eulae.*

Based upon examination of herbarium specimens and field observations, we consider *Hymenocallis eulae* to be similar to *H. occidentalis* (J. Le Conte) Kunth of eastern states. It was troublesome to the authors that *H. eulae* is documented by only a meager number of herbarium specimens, but from examination of them and careful measurements taken from them, we conclude that no significant floral differences exist between these species. However, obvious differences do occur in leaves. It has been observed and reported in the literature that the leaves of *H. eulae* wither before anthesis (Correll & Johnston, 1970; Correll & Correll, 1972) and are suberect before withering (Howard, 1995). The leaves of *H. occidentalis* are present and arching to nearly prostrate at anthesis. The plants of *Hymenocallis eulae* clump, forming dense flowering clusters (Flory, 1976; Howard, 1995), whereas the plants of eastern *H. occidentalis* occur singly or only loosely clumped.

Cytological information also supports an affinity between *H. eulae* and *H. occidentalis.* Flory (1976) reported the chromosome number of *Hymenocallis occidentalis* as $2n = 54$, with 38 two-armed and 16 telocentric chromosomes, and the number of *Hymenocallis eulae* as $2n = 52$, with 40 two-armed and 12 telocentric chromosomes. Although the numbers of chromosomes are different, the total number of chromosome arms is the same, both 92, and this suggests a genetic correspondence between the two numbers (Flory & Schmidhauser, 1957; Flory, 1976).

Based on information from morphology, distribution, and cytology, we submerge *Hymenocallis eulae* as a variety within *H. occidentalis* in our treatment for *Flora of North America.*

Hymenocallis occidentalis (J. Le Conte) Kunth, Enum. Pl. 5: 856. 1850. *Pancratium occidentale* J. Le Conte, Ann. Lyceum Nat. Hist. New York 3: 146. 1836. TYPE: U.S.A. western Georgia, Collector(s) and number unknown (holotype, PH not seen).

Hymenocallis bidentata Small, Manual of the Southeastern Flora. 323. 1933. TYPE: U.S.A. Alabama: St. Bernard, Oct. 1920, *Bede Knapke s.n.* (holotype, NY not seen).

Hymenocallis moldenkiana Traub, Pl. Life 18: 71. no. 21. 1962. TYPE: U.S.A. Georgia: Appling Co., from bulbs collected by Mary G. Henry (T-223) (holotype, MO 272a and b).

Bulb non-rhizomatous, globose, 3.5–5.5 × 3–4.5 cm, neck 1.5–4 cm, basal plate 1–3 cm long; tunic dark brown. *Leaves* 5 to 12, arching to suberect, oblanceolate, shallowly channeled, 3.5–6 dm × 2–6 cm, non-coriaceous, tapering to a petiole-like state, glaucous when young, apex acute. *Scape* (4–) 5–7 dm, two-edged, glaucous; 2 lanceolate scape bracts enclosing the buds, distally long-acuminate, 4–7 cm × 10–15 mm; each flower with a subtending narrowly lanceolate bracteole, 2.5–4.5 cm × 5–10 mm. *Flowers* 3 to 9, opening sequentially with a heavy sweet fragrance; perianth segments slightly ascending, white, green-striped on keel, (7–)8.5–11.5 cm × 5–10 mm; perianth tube green, slender, 7–13.5 cm long; staminal cup white with small, faint yellow-green eye, funnelform, shortly tubulose below, 2.5–4(–4.5) × 4–5.5 cm, margin often irregularly tridentate between the free filaments; free filaments nearly erect, inserting at a flat sinal base, white, 2.5–4 cm; anthers 1.3–2 cm, pollen golden; style green in distal third but fading into white proximally, 13–23 cm; ovary ovoid, 0.8–1.5 cm × 4–7 mm; ovules 2–3 per locule. *Fruit* broadly trigonous to subglobose, ca. 2.5 × 2 cm. *Seeds* subcircular, 1.5–2.1 × 1.2–1.6 cm. $2n = 52$ or 54.

The type variety of *Hymenocallis occidentalis* (Fig. 1) is distinguished by leaves up to 6 cm wide, appearing in late winter and dying off after anthesis; scape bracts 4.5 to 7 cm long. $2n = 54$. Woodland or northern spider-lily.

Phenology. Flowering summer–early fall.

Distribution. Floodplain forests, hammocks, meadows, wooded hillsides, 27–1075 m; southeastern U.S.A. from Louisiana through the Cumberland Plateau to western Carolinas, northwest to Illinois and Indiana and south to western Georgia to the northern panhandle of Florida.

Hymenocallis occidentalis (J. Le Conte) Kunth var. **eulae** (Shinners) G. Lom. Smith & Flory, comb. et stat. nov. Basionym: *Hymenocallis eulae* Shinners, Field & Lab. 19: 102–104. 1951. TYPE: U.S.A. Texas: Van Zandt Co., N of Edgewood near Ocean Lake cultivated at J. A. White house having been introduced from wild plants on Sabine River, 6 Sep. 1946, *Eula Whitehouse 16448* (holotype, BRIT; isotype, MO).

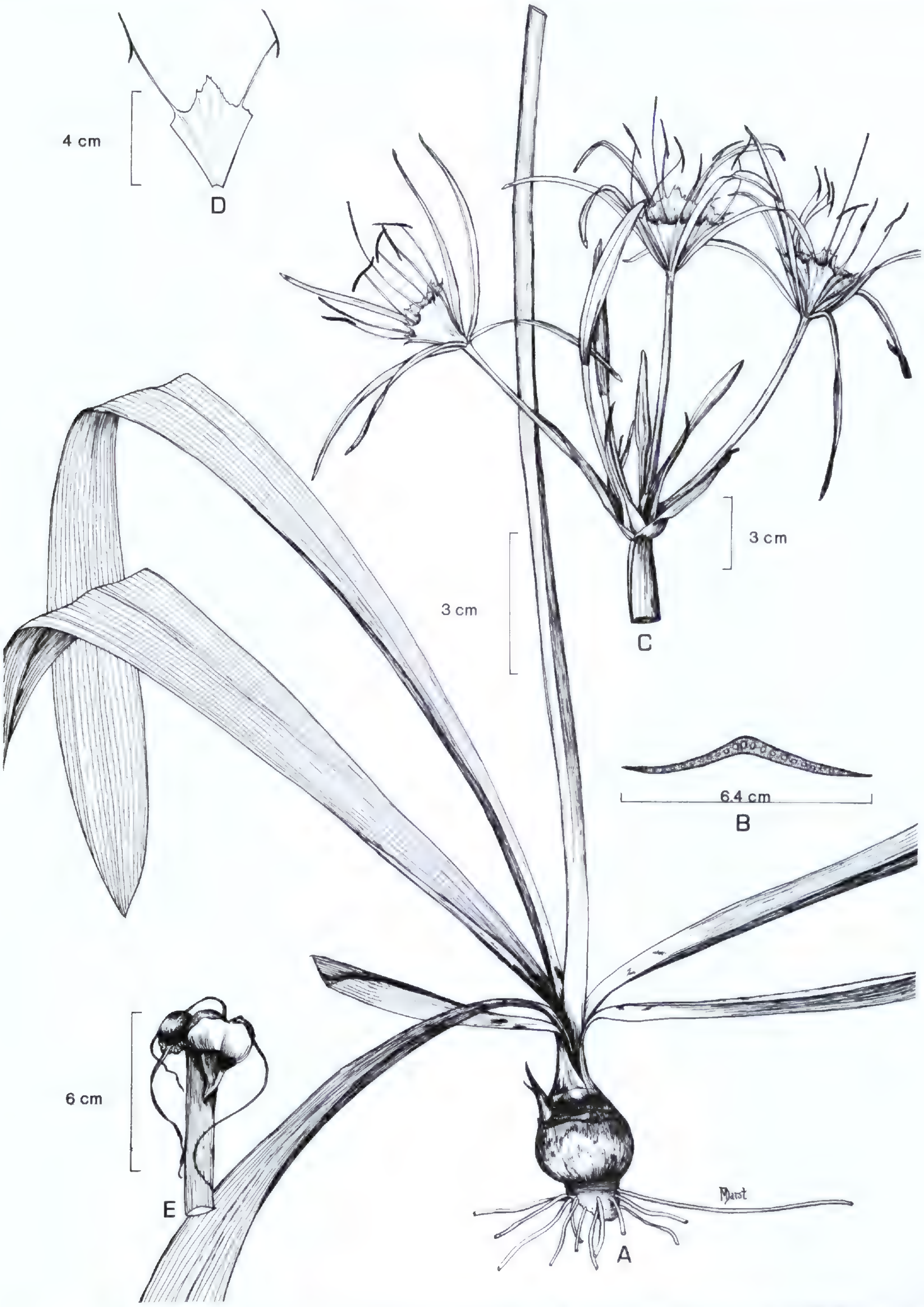


Figure 1. *Hymenocallis occidentalis* var. *occidentalis*.—A. Habit. —B. Leaf cross section. —C. Inflorescence. —D. Section of staminal cup. —E. Dehiscing capsule. Drawn by Melanie Darst from *Smith, Godfrey, Garland & Moretz 1553* (Florida, Liberty Co.: bluffs of Torreya State Park, 2 July 1991).

Hymenocallis occidentalis var. *eulae* is distinguished by leaves to 5 cm wide, appearing in late winter and dying off in summer before anthesis; scape bracts 4–5 cm long; $2n = 52$.

Phenology. Flowering mid summer–early fall.

Distribution. In sandy, piney woods or in heavy soils near streams that periodically overflow and seepage slopes; prairies in western part of range; 50–100 m; eastern Texas and southeastern Oklahoma.

Specimens examined. U.S.A. **Oklahoma:** McCurtain Co., in pine woods, 3 mi. N of Broken Bow, 4 Apr. 1949, *Henry 5533* (PH). **Texas:** Gregg Co., 27 July 1939, *York s.n.* (TEX); Grimes Co., about 2 mi. SE of Shiro, pinelands, 12 Sep. 1968, *Correll 36445* (TEX); Red River Co., dry sandy soil at edge of woods, among scrub oak, 7 mi. N of Clarksville, 5 July 1950, *Henry 5954* (PH); Shelby Co., 6.8 mi. S Shelbyville on state hwy. 147 in secondary growth, pine-hardwood stand, sandy clay hillside, leaves glaucous, 16 May 1966, *Shinners 31353* (BRIT); Smith Co., Tyler State Park, 7 Aug. 1950, *Cory 57515* (BRIT); Tyler State Park, 8 Aug. 1997, *Smith & Moretz 1708* (HPU).

The following key distinguishes between *Hymenocallis occidentalis* var. *occidentalis* and *H. occidentalis* var. *eulae*:

1a. Leaves fresh at anthesis, arching to nearly prostrate; plants single or only loosely clumped . . . . . *Hymenocallis occidentalis* var. *occidentalis*

1b. Leaves withering before anthesis, suberect; plants clumped, forming dense flowering clusters . . . . . *Hymenocallis occidentalis* var. *eulae*

Acknowledgments. Nancy Morin and MO are thanked for the opportunity to study the Traub *Hymenocallis* collections and for arranging loans from BM, F, GH, K, LSU, P, and SMU studied at MO in August of 1992. TEX (including LL) and TAMU are thanked for their loans to HPU. Melanie Darst is thanked for the beautiful illustration of *Hymenocallis occidentalis* var. *occidentalis*. Mark Garland is thanked for his assistance in providing key literature resources and Latin translations. C. Craig Moretz is thanked for field assistance during a trip to east Texas. Bob Kiger is thanked for his initial review of this article. FNA is thanked for their support of its publication.

Literature Cited

Baker, J. G. 1888. Handbook of the Amaryllideae. George Bell & Sons, London. [Facsimile 1972, J. Cramer, Lehre.]

Correll, D. S. & H. B. Correll. 1972. Aquatic and Wetland Plants of Southwestern United States. Environmental Protection Agency, Washington. [Reissued in 2 vols. 1975, Stanford Univ. Press, Stanford.]

——— & M. C. Johnston. 1970. Manual of the Vascular Plants of Texas. Texas Research Foundation, Renner.

Flory, W. S. 1976. Distribution, chromosome numbers and types of various species and taxa of *Hymenocallis*. Nucleus 19: 204–227.

——— & T. F. Schmidhauser. 1957. Mitotic chromosome numbers in *Hymenocallis* with a consideration of factors possibly affecting numbers and karyotypes. Genetics 26: 269.

Herbert, W. 1837. Amaryllidaceae. James Ridgeway and Sons, London. [Facsimile 1970, J. Cramer, Lehre.]

Howard, T. M. 1995. The correct identity of *Hymenocallis galvestonensis* (Herb.) Amaryllidaceae. Herbertia 50: 48–59. [Volume 50 spans two years from 1994 to 1995. The effective date of publication of this article is 15 June 1995.]

Rafinesque, C. S. 1817. Florula Ludoviciana. C. Wiley, New York. [Facsimile 1967, Hafner Publishing, New York.]

Shinners, L. H. 1951. North Texas species of *Hymenocallis*. Field & Lab. 19: 102–104.

Whitehouse, E. 1936. Texas Flowers in Natural Colors. Privately published, Austin.

A New Species of *Hymenocallis* (Amaryllidaceae) in the Lower Central Florida Panhandle

Gerald L. Smith

Biology Department, High Point University, University Station-Montlieu Avenue, High Point, North Carolina 27262-3598, U.S.A.

Loran C. Anderson

Department of Biological Science, Florida State University, Tallahassee, Florida 32306-4370, U.S.A.

Walter S. Flory

Biology Department, Wake Forest University, Box 7325, Reynolda Station, Winston-Salem, North Carolina 27109-7325, U.S.A. (deceased, 8 June 1998)

ABSTRACT. A new species of spider-lily, *Hymenocallis franklinensis*, is described in the lower central Florida panhandle. It is endemic to the lower Ochlockonee River drainage. The new species is distinguished from other *Hymenocallis* by its narrowly liguliform leaves, lanceolate scape bracts that distinctly taper in the distal half, subglobose fruits, and its chromsome numbers of $2n = 43, 44$. A key is provided to distinguish among similar species.

Key words: Amaryllidaceae, Florida, *Hymenocallis*, North America, U.S.A.

In the spring of 1991, Loran C. Anderson observed spider-lilies (Fig. 1) blooming along a side channel of the lower Ochlockonee River (Fig. 2). Anderson pressed the specimens as *Anderson 13382* (Fig. 1). In late May of 1991, Smith examined this collection and was puzzled by its morphology. The leaves were narrowly liguliform, apparently coriaceous, and judged to be similar to leaves of *Hymenocallis crassifolia* of Herbert observed just a few weeks earlier in the outer Coastal Plain wetlands of the Carolinas. However, the flowers and the subtending bracts were decidedly more robust. This collection was deemed unique in its combination of characters and became a leading candidate for further studies. Anderson took Smith to Cow Creek in June 1991, and living *Hymenocallis* plants in a vegetative state were collected and vouchered as *Smith & Anderson 1531* to be used in both morphological and cytological analyses.

MATERIALS AND METHODS

All morphological features of *Anderson 13382* were critically examined and carefully measured. A description was prepared of this collection. Additional morphological data were gathered from the following collections: *Smith, Garland & Knight 1631*, *Smith & Anderson 1717*, *Anderson 16814*, and *Anderson 18299*. *Hymenocallis* bulb collections were also made from Bear Creek adjacent to Cow Creek (Fig. 3) by Anderson and Garland and Knight. These collections were sent to Smith without number, and he potted these bulbs and added them to his living collections of *Hymenocallis*.

The measurements presented in the description, with the exception of the bulb and seed and fruit dimensions, were made from dried, well-pressed specimens. Fresh measurements were made of the bulbs and seeds and fruits, as they could not be adequately pressed to show their proper dimensions.

CYTOLOGY

Cytological analyses were undertaken on the *Hymenocallis* bulb collections that were obtained from Cow Creek and Bear Creek. The source of the analyses were actively growing root tips from potted bulbs. The cytological techniques used were those followed in Jones and Luchsinger (1986) as adopted from Flory and Smith (1980). Well-spread metaphase figures were examined with a Leitz microscope and photographed in Flory's laboratory at Wake Forest University or with a Wolfe microscope in Smith's laboratory at High Point University. Counts were obtained from the following collections listed in Table 1.

Smith and Anderson 1531 was the first *Hymenocallis* bulb collection from which a chromosome count was obtained for the Cow Creek spider-lilies.

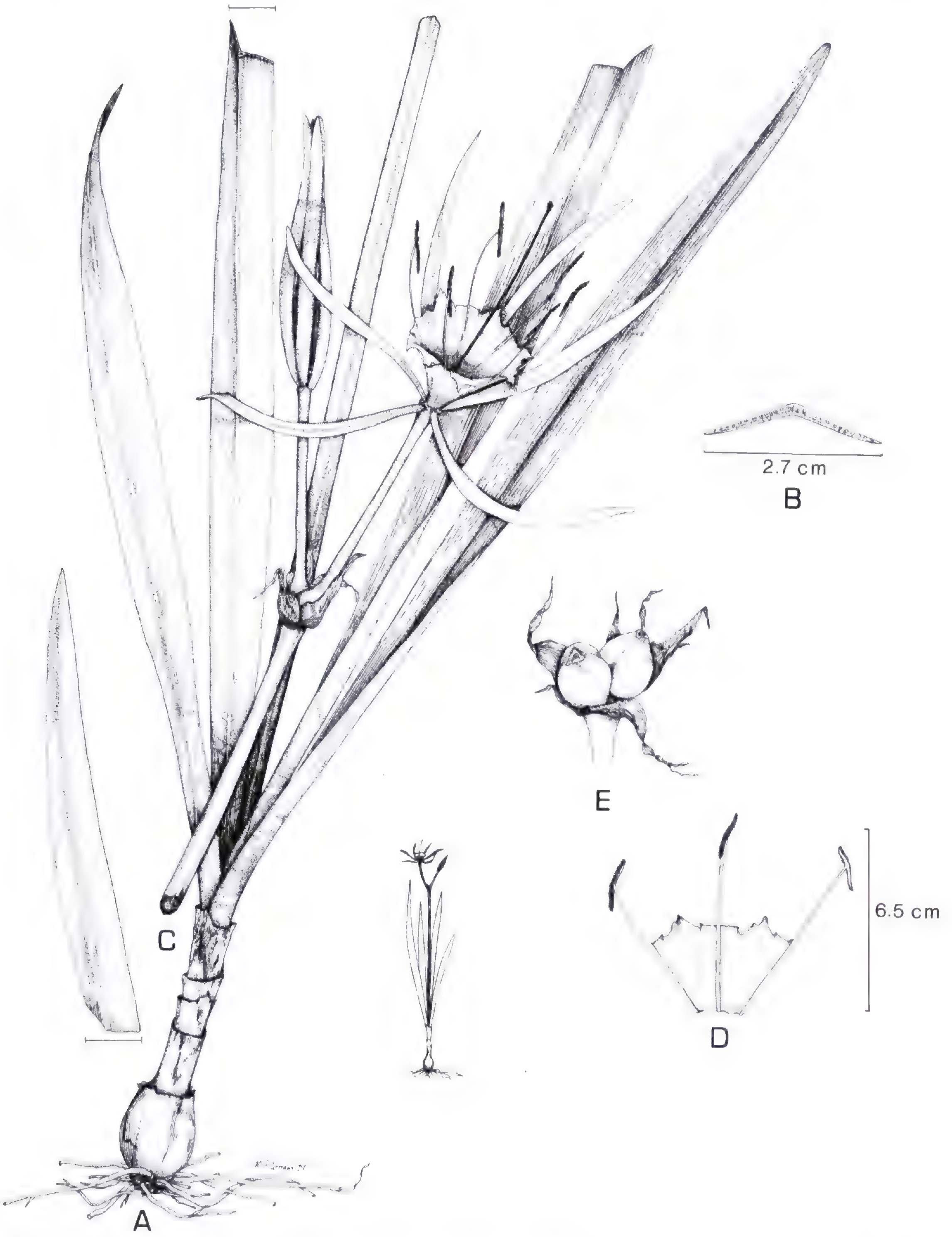


Figure 1. *Hymenocallis franklinensis* G. Lom. Smith, Anderson & Flory. —A. Habit, plant aspect at right. —B. Leaf cross section. —C. Scape with 2-flowered inflorescence. —D. Section of staminal cup. —E. Developing fruits. (Drawn by Jean Putnam Hancock.)

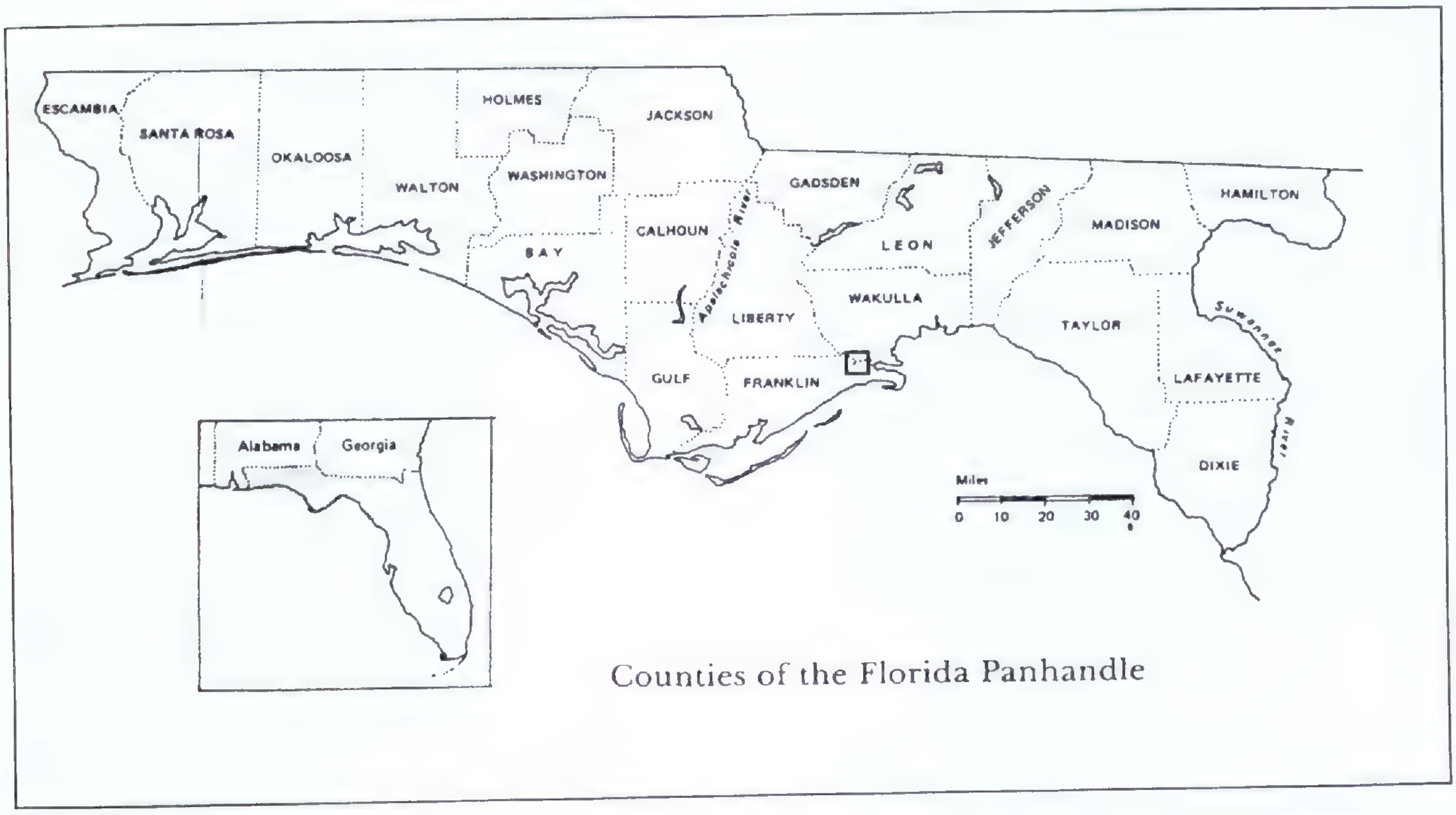


Figure 2. The block encloses the lower Lower Ochlockonee River drainage, which forms the far northeastern border of Franklin County, Florida, separating it from Wakulla County. Map from A. F. Clewell, *Guide to the Vascular Plants of the Florida Panhandle*, used with permission of University Presses of Florida, Gainesville.

As shown in Table 1, it was $2n = 44$. This count indicated an affinity to *Hymenocallis choctawensis*, which also had been determined to have that number (Fig. 4) (Smith et al., 1991). As noted in Table 1, most of the other counts determined for spider-lilies in the lower Ochlocknee River drainage were also $2n = 44$, including *Smith & Anderson 1717* (Fig. 5).

Cytological analyses of *Smith et al. 1631* revealed an unexpected count. Repeated counts of this collection showed its chromosome number to be $2n = 43$, with 37 two-armed chromosomes and 6 telocentric chromosomes (Fig. 6).

An interesting relationship exists between the somatic chromosome numbers of 43 and 44. The count of 43 from *Smith et al. 1631* comprises 37 two-armed chromosomes and 6 telocentric chromosomes. The count of 44 from the other collections comprises 36 two-armed chromosomes and 8 telocentric chromosomes. Although chromosome numbers are different, the number of chromosome arms is the same, 80. Such an equivalency in arm number is suggestive of genetic correspondence as indicated by Flory and Schmidhauser (1957) and Flory (1976). It is not known what influence the presence of two chromosome races among the Cow Creek spider-lilies may contribute to their genetic distinctiveness, but centric fission, which likely produced the telocentric chromosomes, is considered to be a mechanism of speciation in *Hymenocallis* (Flory, 1976).

Nomenclature and Morphology

Based on our field, herbarium, and cytological analyses, we have decided to recognize the spider-lily populations along the lower Ochlockonee River drainage as the new species *Hymenocallis franklinensis*. It is possibly a local endemic. Populations may also be sought among the Sopchoppy River drainage, but have not been investigated by the authors. All the collections to date have been made from Franklin County, with the exception of one collection that has been made from adjacent Wakulla County at Shepherd's Spring in St. Marks National Wildlife Refuge (*Anderson 16814*). Distinguishing characteristics are the narrowly liguliform, nearly erect, lustrous leaves; moderately robust flowers with funnelform staminal cup; lanceolate scape bracts that distinctly taper in the distal half; and subglobose fruits with obovoid seeds.

Hymenocallis franklinensis G. Lom. Smith, L. C. Anderson & Flory, sp. nov. TYPE: U.S.A. Florida: Franklin Co., opposite the boat landing at end of CR-370, bordering Cow Creek near its confluence with the Ochlockonee River, 1 mi. E of hwy. 319, 27 Apr. 1991, *Anderson 13382* (holotype, FSU). Figure 1.

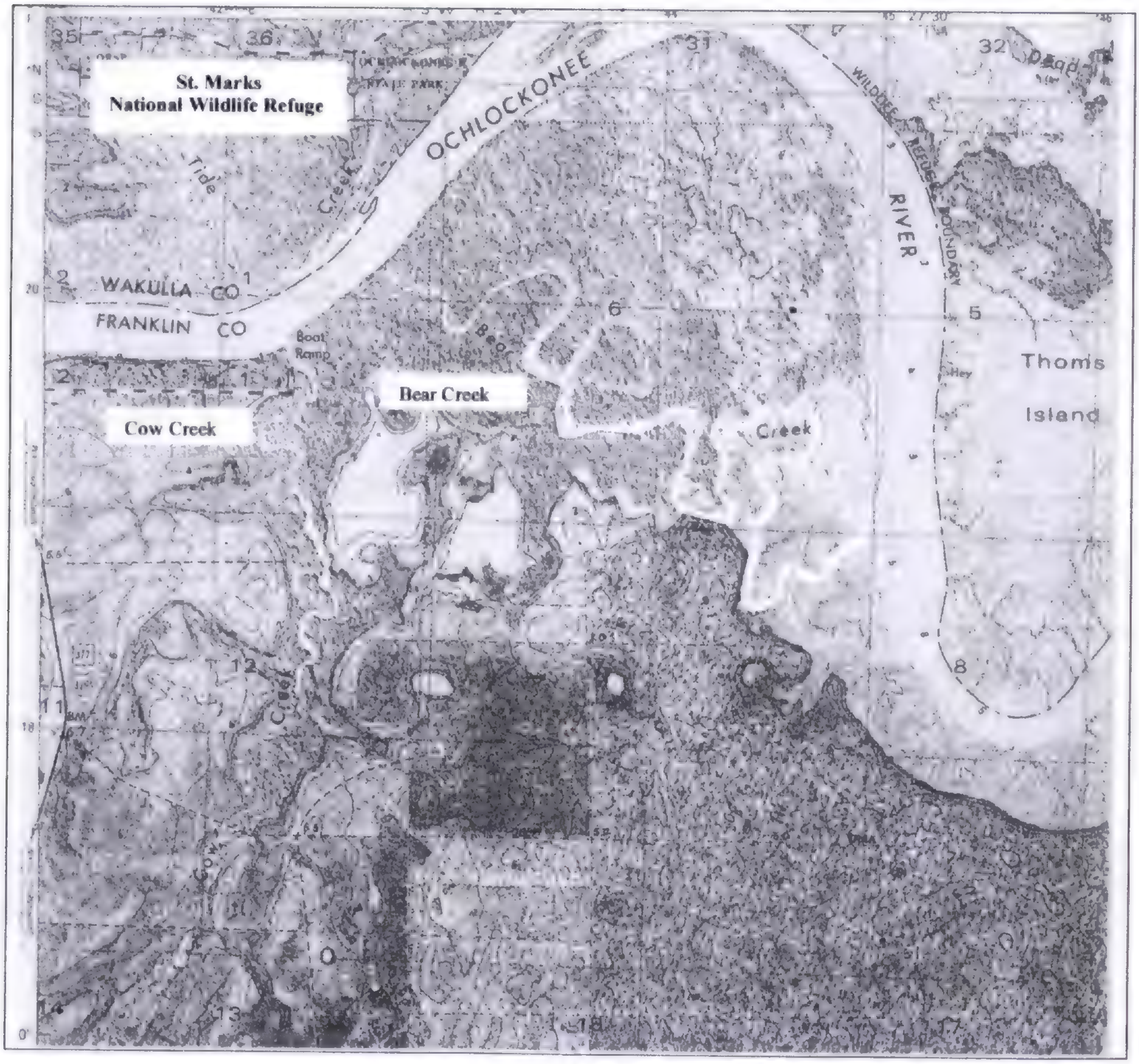


Figure 3. Topographic enlargement of the portion of the block in Figure 2 showing the bow of the lower Ochlockonee River (Franklin County) and the tributaries of Cow Creek and Bear Creek. Note St. Mark's National Wildlife Refuge to the northwest in adjacent Wakulla County.

Planta ex bulbo rhizomatoso, anguste ovoideo, 2.5–4.5 × 2–3.5 cm, collo 3.5–7 cm longo. Folia 3 ad 5, fere erecta, lucida, anguste liguliformia, distincte canaliculata, coriacea, 2.8–4.8 dm × 1.8–2.7 cm. Inflorescentia bi- vel triflora; scapo ancipitio, glauco, 3–4.5 dm longo; bracteis scapi 2, gemmas includentibus, 3–4.5 cm × 10–15 mm. Flores 2 ad 3, fragrantes; perianthii tubo viridi, 6.5–9 cm longo; segmentis parum ascendentibus, albis; poculo staminum albo infundibuliformi in aetate gradatim patente, 3–4 × 4–5.5 cm; antheris 1.5–1.8 cm longis; polline aureo; stylo 14–17 cm longo; ovario ovoideo, 1–1.5 cm × 5 mm; ovulis 2 vel 3 in quoque loculo. Capsula subglo-

Table 1. Chromosome counts made from collections from tributaries of the lower Ochlockonee River in Franklin County, Florida.

Collection	Sites	2n
Smith & Anderson 1531	Cow Creek	44 (36 + 8T*)
Smith, Knight & Garland 1631	Cow Creek	43 (37 + 6T)
Smith & Anderson 1717	Cow Creek	44 (36 + 8T)
Garland & Knight 831	Cow Creek	44 (36 + 8T)
Anderson s.n.	Bear Creek	44 (36 + 8T)
Garland & Knight s.n.	Bear Creek	44 (36 + 8T)

* Telocentric.

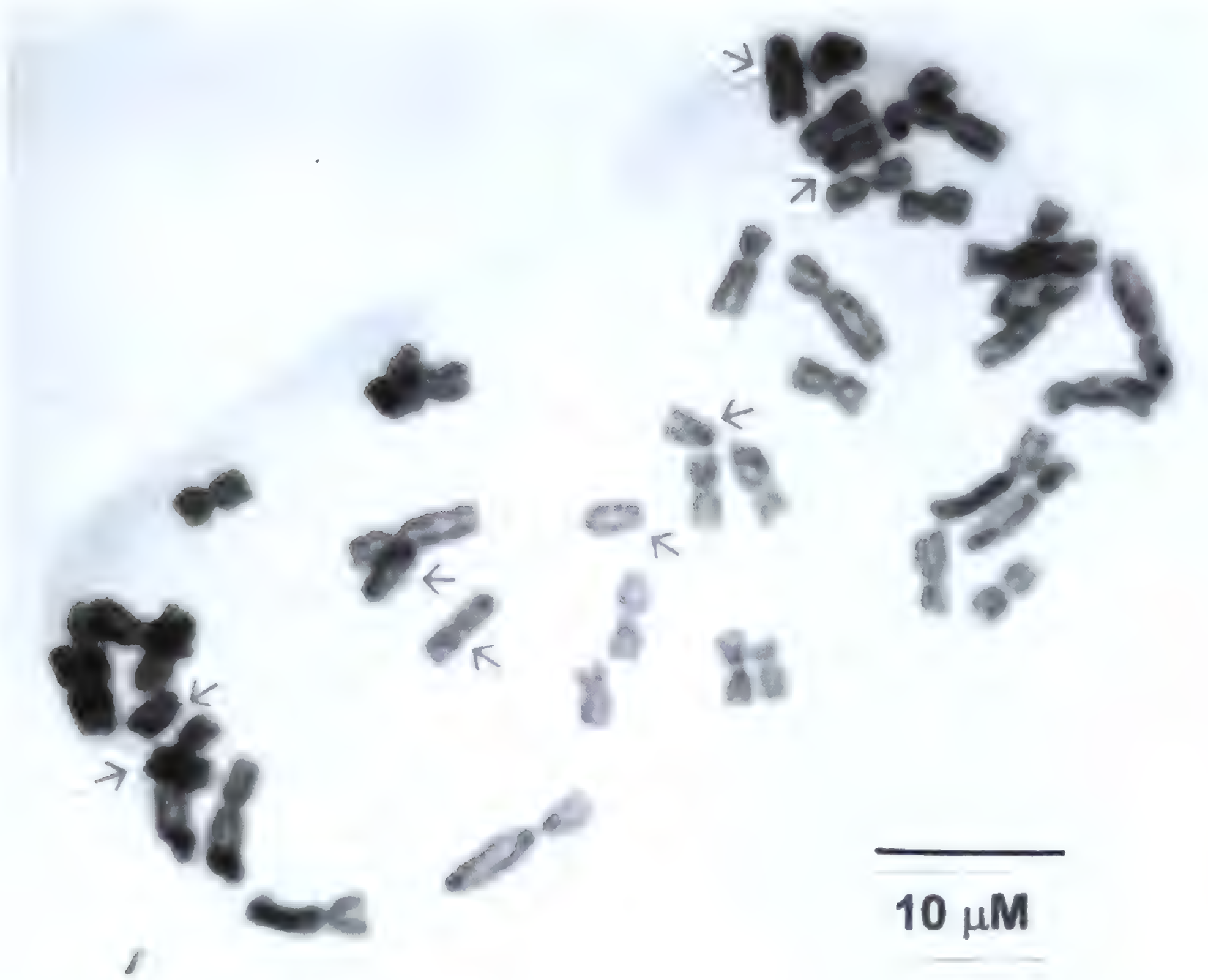


Figure 4. Somatic chromosomes of *Hymenocallis choctawensis*, $2n = 44$, from *Smith & Garland 1432*. Arrows point to 8 telocentric chromosomes.

bosa, 2–2.5 × 2–2.5 cm; seminibus viridibus, carnosis, obovoideis, 1.6–2.0 × 1.2–1.5 cm.

Bulb rhizomatous, narrowly ovoid, 2.5–4.5 × 2–3.5 cm, neck 3.5–7 cm, basal plate 1–2 cm; tunica grayish brown. Leaves 3 to 5, nearly erect, lustrous, narrowly liguliform, distinctly channeled, 2.8–4.8 dm × 1.8–2.7 cm, coriaceous, apex acute. Scape 3–4.5 dm, 2-edged, glaucous; two scape bracts enclosing the buds, 3–4.5 cm × 10–15 mm; each flower with a subtending bract, papery, persistent, 2.5–4.5 cm × 7–12 mm. Flowers 2 or 3, opening sequentially, moderately fragrant; perianth segments slightly ascending, white, tinged green on keel, 8.8–11.5 cm × 5–7 mm; perianth tubes green, 6.5–9 cm; staminal cup white with a small yellowish green proximal eye, funnelform, spreading with age, shortly tubular below, 3–4 × 4–5.5 cm; margin irregularly dentate between free filaments; free filaments suberect, inserting at a flat sinal base, white, 2.5–3.5 cm; anthers 1.5–1.8 cm, pollen golden; styles green in distal third, fading to white, 14–17 cm; ovaries ovoid, 1–1.5 cm × 5 mm; ovules 2 or 3 per locule. Fruits subglobose, 2–2.5 × 2–2.5 cm. Seeds obovoid, 1.6–2.0 × 1.2–1.5 cm. $2n = 43, 44$.

Phenology. Flowering begins in mid April and continues into mid May.

Distribution and Ecological Associates

Hymenocallis franklinensis, as we know it, appears to be most abundant along Cow Creek, a southern tributary of the lower Ochlokonee River (Fig. 3). It forms the boundary between Franklin and Wakulla Counties.

Herbaceous plants along the margins of Cow Creek include: *Alternanthera philoxeroides* (Martius) Grisebach, *Canna flaccida* Salisbury, *Cicuta mexicana* Coulter & Rose, *Cladium jamaicense* Crantz, *Crinum americana* L., *Helenium flexuosum* Rafinesque, *Iris hexagona* Walter, *Juncus* spp., *Orontium aquaticum* L., *Osmunda regalis* L., *Peltandra virginica* (L.) Schott & Endlicher, *Physostegia leptophylla* Small, *Polygonum densiflorum* Meissner, *Pontederia cordata* L., *Sagittaria lancifolia* L., *Samolus valerandi* L. subsp. *parviflorus* (Rafinesque) Hultén, *Saururus cernuus* L., *Senecio glabellus* Poiret, and *Zizaniopsis miliacea* (Michaux) Döll & Ascherson. Shrubs, vines, and trees include: *Acer rubrum* L., *Amorpha fruticosa* L., *Am-*

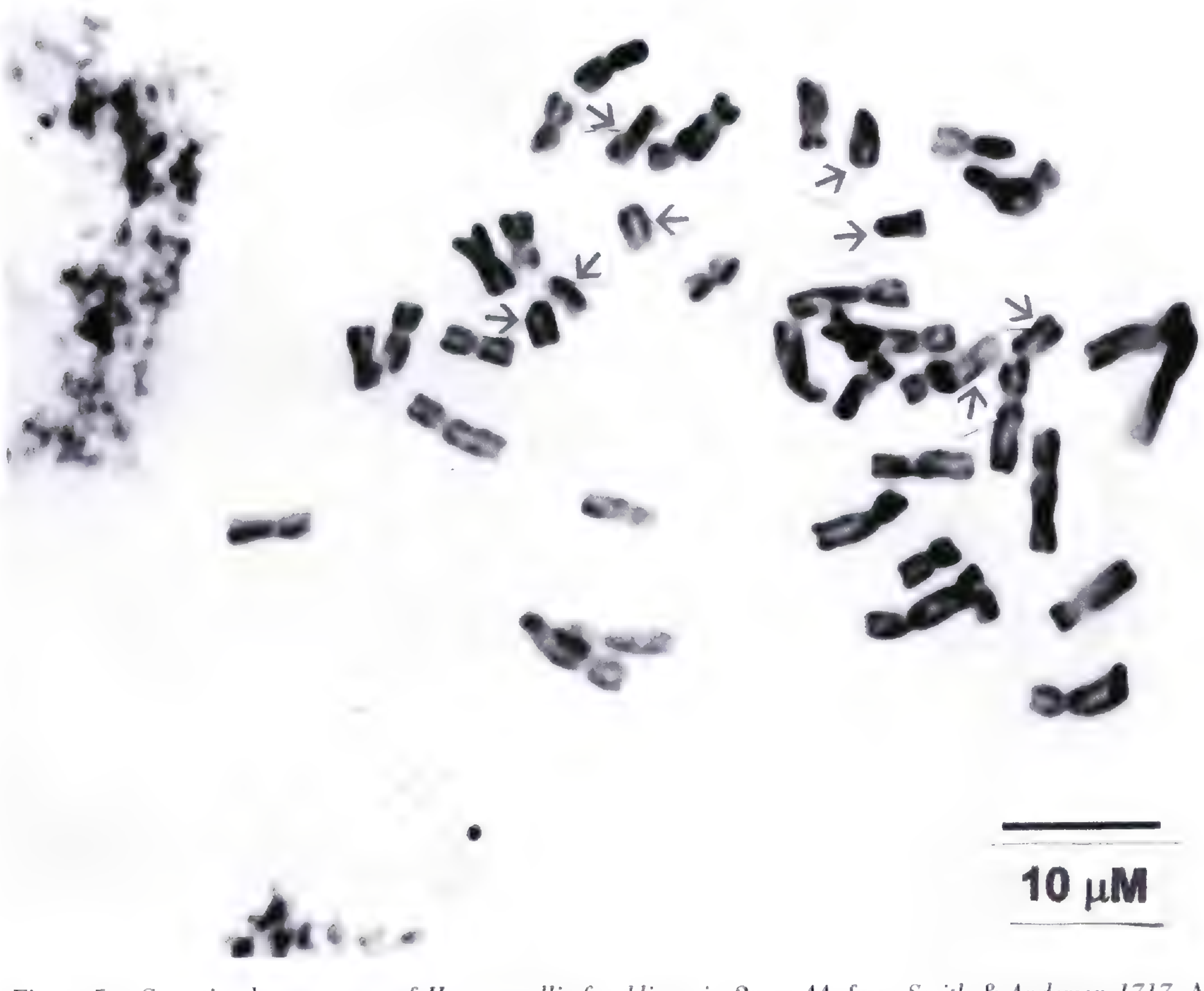


Figure 5. Somatic chromosomes of *Hymenocallis franklinensis*, $2n = 44$, from *Smith & Anderson 1717*. Arrows point to 8 telocentric chromosomes.

pelopsis arborea (L.) Koehne, *Cephalanthus occidentalis* L., *Chionanthus virginicus* L., *Hypericum* spp., *Ilex vomitoria* Aiton, *Itea virginica* L., *Fraxinus caroliniana* Miller, *Liriodendron tulipifera* L., *Magnolia virginiana* L., *Myrica cerifera* L., *Nyssa sylvatica* Marshall var. *biflora* (Walter) Sargent, *Nyssa ogeche* Bartram ex Marshall, *Persea palustris* (Rafinesque) Sargent, *Rhododendron viscosum* (L.) Torrey, *Taxodium ascendens* Brongniart, and *Toxicodendron radicans* (L.) Kuntze. *Hymenocallis* was more abundant in the open areas along the creek, particularly in association with *Iris hexagona* Walter. All of the above associates have been vouchered by Loran Anderson in the FSU Herbarium.

Discussion

In our quest to determine the identity of the new species, we initially considered *Hymenocallis duvalensis* Traub and *H. crassifolia* Herbert. The former similarly occurs along the Ochlockonee River in the northern Florida panhandle and is distributed northward into south-central Georgia. However, leaves in *H. duvalensis* are not as coriaceous and neither its flowers nor its bracts as robust as those of the new species. *Hymenocallis crassifolia*, which occurs from the outer Coastal Plain of the Carolinas to northeastern Florida but not into Franklin County or the Florida panhandle, has leaves that correspond to those of *H. franklinensis*, but its flowers and bracts are proportionately smaller. An important consideration of the taxonomy of *Hymenocallis crassifolia*, *H. duvalensis*, and *H. franklinensis* is that all three species have consistently different chromosome numbers (respectively, $2n = 40$, 42, and 44) and karyotypes.

The species to which *Hymenocallis franklinensis* seems most closely related is *H. choctawensis*, described by Traub (1962) from a bulb collection made by Mary G. Henry in the western Florida panhandle. This relationship is likely supported by the common chromosome number of $2n = 44$ (Smith & Anderson, 2000) and by an overall similarity in floral characteristics. The shape of the cup and the dentate margin are much alike, and the tepal tube lengths and the perianth dimensions are of similar values. However, the two species can be distinguished by their scape bracts and fruits. The bracts of *Hymenocallis franklinensis* are lanceolate and taper distinctly over the distal half. Its fruits are smaller, subglobose, and 2–2.5 cm long by 2–2.5

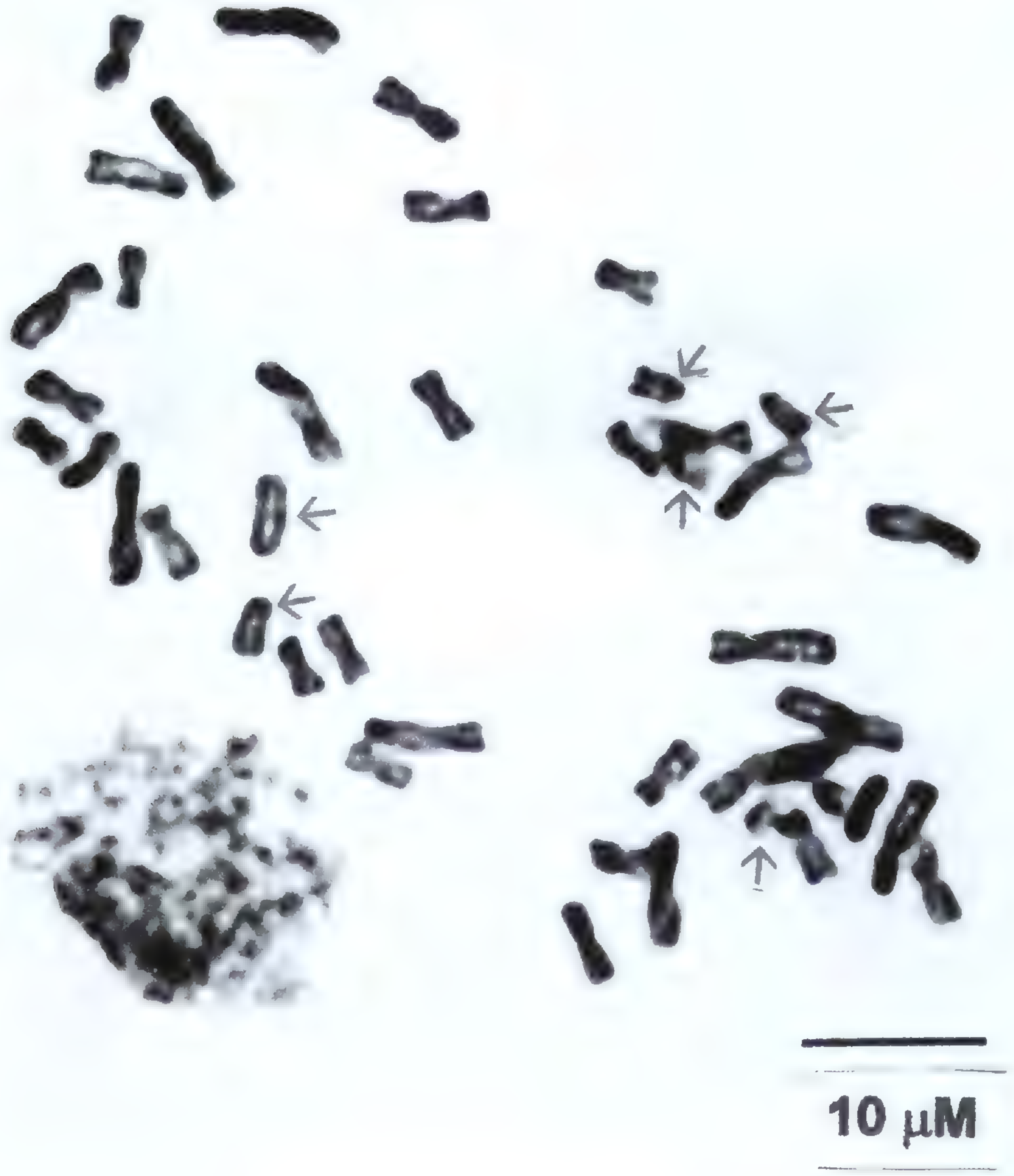


Figure 6. Somatic chromosomes of *Hymenocallis franklinensis*, $2n = 43$, from *Smith, Garland & Knight 1631*. Arrows point to 6 telocentric chromosomes.

cm wide. In *Hymenocallis choctawensis*, the bracts are triangular and are not long tapering in the distal half. Its fruits are broadly trigonous and measure 3–4 cm long by 3 cm wide, larger than the 2.5 × 2.5 cm ones of *H. franklinensis*. Most distinctive are the leaves of *H. franklinensis* being narrowly liguliform, nearly erect, channeled throughout their length, and lustrous, in sharp contrast with the wider oblanceolate, arching, only proximally channeled, and more brightly green leaves of *H. choctawensis* (Smith & Garland, 1996).

The following key distinguishes among five species of *Hymenocallis* found in Florida that are likely to be confused with one another.

1a. Leaves oblanceolate, 2.5–6 cm wide.
  2a. Scape bracts with apex acute, 3–6 cm long; bulb ovoid, rhizomatous . . . . . *H. choctawensis* Traub
  2b. Scape bracts with apex long acuminate, 4–7 cm long; bulb globose, nonrhizomatous . . . . . *H. occidentalis* (J. Le Conte) Kunth
1b. Leaves narrowly liguliform or narrowly oblanceolate, 1–2.7 cm wide.
  3a. Scape bracts, lanceolate, 3.5–5 cm × ca. 15 mm . . . . . *H. franklinensis* G. Lom. Smith, Anderson & Flory
  3b. Scape bracts narrowly lanceolate, 2.5–6 cm × 5–10 mm.
    4a. Staminal cup funnelform at peak anthesis, 2–3 × 3.5–4.5 cm; leaves nearly erect, channeled for most of their length . . . . . *H. crassifolia* Herbert
    4b. Staminal cup rotate at peak anthesis, 3–4 × 4–5.5 cm; leaves arching, channeled proximally . . . . *H. duvalensis* Traub

Paratypes. U.S.A. **Florida:** Franklin Co., CR-370 access, Cow Creek near its confluence with the Ochlockonee River, 1 mi. E. of hwy. 319, 13 June 1991, *Smith & Anderson 1531* (FSU), 13 June 1991, *Smith & Anderson 1532* (FSU, HPU), 16 May 1992, *Garland & Knight 831* (FSU), 16 Apr. 1994, *Smith, Garland & Knight 1631* (FLAS, FSU, GA, HPU, MO, USF); 4 Apr. 1998, *Smith & Anderson 1717* (HPU), 22 Apr. 1998, *Anderson 18299* (FSU). Wakulla Co., Shepherd's Spring of St. Marks National Wildlife Refuge, 22 July 1996, *Anderson 16814* (FSU).

Acknowledgments. Mark Garland and Gary Knight are thanked for their assistance in providing collections from Cow Creek and Bear Creek. Additionally, Mark is thanked for sharing his expertise in Latin by providing the diagnosis, and Gary is thanked for sharing his photographic expertise by providing high-quality slides of the Cow Creek spider-lilies, which proved very helpful in developing the description. Jean P. Hancock is thanked for her beautiful detailed illustration of *Hymenocallis franklinensis*. Craig Moretz is thanked for supplying the transportation to carry my 1991 Florida bulb collection, which included Cow Creek bulbs, to my greenhouse in North Carolina. Funding for this project was provided in part by North Carolina Board of Science and Technology Grant no. 90SE010 to Smith and High Point University. We thank Nancy Pennell, HPU faculty secretary, for her computer assistance in preparation of the map figures. The Flora of North America project is thanked for its support of this publication.

Literature Cited

Flory, W. S. 1976. Distribution, chromosome numbers and types of various species and taxa of *Hymenocallis*. Nucleus 19: 204–227.

——— & T. F. Schmidhauser. 1957. Mitotic chromosome numbers in *Hymenocallis* with a consideration of factors possibly affecting numbers and karyotypes. Genetics 26: 269.

——— & G. L. Smith. 1980. The chromosomes of *Habranthus martinezii, H. robustus*, and their F_1 hybrid. Pl. Life 36: 54–62.

Jones, S. B., Jr. & A. E Luchsinger. 1986. Plant Systematics, 2nd Ed. McGraw-Hill, New York, p. 181.

Smith, G. L. & L. C. Anderson. 2000. A new spider-lily species in the lower Florida panhandle. A. S. B. Bull. 47: 199. [Abstract.]

——— & M. A. Garland. 1996. Taxonomic status of *Hymenocallis choctawensis* and *Hymenocallis puntagordensis* (Amaryllidaceae). Sida 17: 305–319.

———, W. S. Flory & M. A. Garland. 1991. Studies on *Hymenocallis choctawensis* Traub in the Florida panhandle. A. S. B. Bull. 38: 122. [Abstract.]

Traub, H. P. 1962. Key to the subgenera, alliances, and species of *Hymenocallis*. Pl. Life 18: 55–72.

Taxonomic Innovations in North American *Eleocharis* (Cyperaceae)

S. Galen Smith
Department of Biology, University of Wisconsin-Whitewater, Whitewater, Wisconsin 53190, U.S.A.

Abstract. Taxonomic innovations for the upcoming volume 23 of the *Flora of North America* (FNA) are here published. *Eleocharis quinqueflora* (F. X. Hartman) O. Schwarz, *E. suksdorfiana* Beauverd, and *E. bernardina* (Munz & I. M. Johnston) Munz & I. M. Johnston are redefined. New taxa described are: *E. occulta* S. G. Smith, segregated from *E. acutisquamata* Buckley; *E. bifida* S. G. Smith, segregated from *E. compressa* Sullivant; *E. torticulmis* S. G. Smith, segregated from *E. suksdorfiana*; and *E. acicularis* (L.) Roemer & Schultes var. *porcata* S. G. Smith, confused with *E. wolfii* (Gray) Gray. Other innovations are: *E. elliptica* Kunth var. *atrata* (Svenson) S. G. Smith, comb. nov.; *E. compressa* var. *acutisquamata* (Buckley) S. G. Smith, stat. nov.; *E. palustris* (L.) Roemer & Schultes var. *vigens* L. H. Bailey, lectotypified.

Key words: Cyperaceae, *Eleocharis*, North America.

Taxonomy in *Eleocharis* is confused because of morphological convergence in habit, vegetative reproduction (tubers, bulbs, stolons, viviparous spikelets), and most structures including culms, leaf sheaths, spikelets and their scales, perianth bristles, style branches, tubercles, and achenes (Gonzalez-Elizondo & Peterson, 1997; Gonzalez-Elizondo et al., 1997; Roalson & Friar, 2000).

This paper contains taxonomic innovations resulting from my work on the treatment of *Eleocharis* for the upcoming volume 23 of the *Flora of North America* (FNA) (Flora of North America Editorial Committee, in press).

Eleocharis is a worldwide genus comprising about 200 species (Gonzalez-Elizondo & Peterson, 1997). The latest comprehensive taxonomic treatment for North America was done by Svenson (1957), who recognized 61 species. About 65 species will be recognized in the FNA treatment. Gonzalez-Elizondo and Peterson (1997) provided a supraspecific classification utilizing four levels of taxonomic categories, which will be followed.

Classification of *Eleocharis* is unusually difficult for two main reasons: (1) The simple structure (unbranched aerial stems; only two leaves, which are basal, sheathing, and without blades or with only rudimentary blades; and a single terminal spikelet without involucral bracts) provides relatively few macroscopic characters. (2) *Eleocharis* includes several extremely difficult species complexes needing taxonomic revision. Many of the species in these complexes have never been precisely defined. Problems of species delimitation are probably due in part to interspecific hybridization, which has been studied mainly in the *E. palustris* complex in Europe (Strandhede, 1965, 1966). Unstable chromosome structure, polyploidy, and aneuploidy associated with diffuse-centromere chromosomes and aberrant meiosis and pollen development (Harms, 1968, 1972; Strandhede, 1965, 1967) doubtless also contribute to taxonomic complexity. This paper resolves some of the taxonomic problems in the *E. palustris* complex, the *E. tenuis-compressa* complex, the *E. quinqueflora* complex (*E.* subg. *Zinserlingia* T. V. Egerova), and the *E. acicularis* compex (*E.* subg. *Scirpidium* (Nees) Kukkonen) in North America.

A. The *Eleocharis palustris* Complex

The *E. palustris* complex comprises subgenus *Eleocharis* sect. *Eleocharis* ser. *Eleocharis* subser. *Eleocharis* (= *E.* ser. *Eleocharis* subser. *Palustres* Svenson). It is circumboreal and comprised of perhaps 10 to 15 species. All of the North American and Eurasian species are difficult to delimit. Strandhede (1965, 1966) studied extensively the 4 species of this complex in northern Europe. It is still poorly understood in North America, for which Svenson (1957) recognized 6 species. I recognize 7 species, which include all 4 European species. For Europe, Strandhede (1966) showed that interspecific hybridization and polyploidy are a major cause of taxonomic difficulties among the species recognized there, and by extrapolation it seems likely that hybridization and polyploidy are also important in North America.

The most widespread and variable species in this complex is the circumboreal *E. palustris* (L.) Roemer & Schultes, within which I am including the North American *E. smallii* Britton as a synonym. For North America, Strandhede (1967) distin-

guished two groups with the morphology of *E. smallii*: (1) $2n = 16$-chromosome plants with achenes 1.2–1.5 mm and culm stomata 39–48 μm long, and (2) $2n = 36$-chromosome plants with achenes 1.6–1.7 mm and stomata 55–60 μm long. Harms (1968) also reported both $2n = 16$ and $2n = 36$ for *E. smallii* in North America. In Europe $2n = 16$ plants of *E. palustris* are placed in subspecies *palustris* and $2n = 38$ or 39 plants are placed in subspecies *vulgaris*, which differs from the North American plants of *E. smallii* with large achenes in having a morphology intermediate with that of *E. uniglumis* (Link) Schultes. I have measured the achenes of Britton's type of *E. smallii* as ca. 1.3 × 1.1 mm and the stomata as 39–43 μm long. Therefore, pending a much needed worldwide taxonomic revision of the *E. palustris* complex, it is desirable to use a name based on a North American type for North American plants like the type of *E. smallii* except for larger achenes and longer stomates associated with $2n = 36$ chromosomes. Hooker's earlier varietal names from Saskatchewan and Lake Huron cannot be used because Hooker's descriptions in the protologue (in Fl. bor.-Amer. 2: 228. 1839) conflict with the morphology of the robust polyploid plants. His descriptions read in their entirety: *E. palustris* Br . . . "β *minor*: spica ovata" and "γ *degenerata*: bi-triuncialis, spica minima 3–5 flora." The following is the only available and acceptable name for these plants:

1. **Eleocharis palustris** (L.) Roemer & Schultes var. **vigens** L. H. Bailey, J. New York Microscop. Soc. 5: 104. 1889. TYPE: U.S.A. Vermont: Franklin Co., shore of Lake Champlain, Highgate Springs, Aug. 1813, *H. G. Jessup s.n.* (lectotype, selected here, GH).

Bailey cited four syntypes in the protologue. Of these only one specimen at GH has been located after searches at GH and BH, and this is selected here as the lectotype.

The lectotype consists of three culms with spikelets in good condition. The few mature achenes are 1.75 × 1.35–1.5 mm. The culm stomates are ca. 60 μm long. The culms are 2.5–3 mm thick when not pressed flat. The following specimens were collected at or near the syntype localities and are very similar to the lectotype: U.S.A. New York: Erie Co., shallow water N of Buckhorn Island, Niagara River, 27 Aug. 1928, *W. C. Muenscher 17160* (BH); shallow water around Strawberry Island, Niagara River, 21 Aug. 1928, *W. C. Muenscher 17159* (BH). Vermont: Chittenden Co., Shelburne Bay, Lake Champlain, 26 Aug. 1926, *W. C. Muenscher & B. Maguire 275* (BH) [stomata 59–65 μm]. I have seen very similar specimens from Canada: Manitoba (Churchill), New Brunswick, Newfoundland, Nova Scotia, Ontario, Quebec, Isle of Miquelon; U.S.A.: Maine, Michigan, Nebraska, New York, Wisconsin.

Plants of *E. palustris* var. *vigens* are ca. 50–120 cm tall, and the culms (not pressed flat) are ca. 1.5–4 mm thick, which is very robust compared to most other *E. palustris* plants. They are often emergent in water to ca. 1 m deep.

B. The *Eleocharis tenuis-compressa* Complex

This complex is part of *Eleocharis* subg. *Eleocharis* sect. *Eleocharis* ser. *Eleocharis* subser. *Truncatae* Svenson. It is restricted to North America, where it is widespread except in the Southeast and Southwest. Svenson (1957) recognized the following five species: *E. tenuis* (Willdenow) Schultes, in Roemer & Schultes, *E. elliptica* Kunth, *E. compressa* Sullivant, *E. acutisquamata* Buckley, and *E. nitida* Fernald. I recognize *E. tenuis*, *E. elliptica*, *E. compressa*, *E. nitida*; and *E. bifida* S. G. Smith and *E. occulta* S. G. Smith, both described herein.

Except for *E. nitida*, species delimitation in this complex is difficult because many plants are intermediate between *E. tenuis* and *E. elliptica*, between *E. elliptica* and *E. compressa*, and between *E. compressa* and *E. acutisquamata*. Also, a few plants are intermediate between *E. compressa* and *E. tenuis* var. *verrucosa* (Svenson) Svenson. Some authors (Boivin, 1979; Gleason, 1968; Gleason & Cronquist, 1991; Taylor, 1983) have dealt with these intermediates by combining two or more species. Combining these species, however, effectively obscures differences in morphology, ecology, and distribution that are useful in ecology and other fields. Therefore, it is preferable to more precisely define the species that have long been recognized, and to recognize them whenever most specimens can be identified with confidence.

The many plants intermediate between *E. compressa* and *E. elliptica* led Drapalik and Mohlenbrock (1960a, 1960b) and Rolfsmeier (1995) to combine them, while other authors (Voss, 1972; Swink & Wilhelm, 1994) have maintained them as distinct species. I have defined *E. elliptica* broadly to include some plants often included under *E. compressa* (see Voss, 1972). Most specimens can be identified with confidence to *E. elliptica*, *E. compressa*, *E. occulta*, or *E. bifida*. My field observations in southeastern Wisconsin and herbarium studies suggest that the intermediate plants are hybrids and that there is considerable reciprocal introgression. The new status *E. elliptica* var. *atrata*

(Svenson) S. G. Smith made herein provides a varietal name in which to place the plants of *E. elliptica* that approach *E. compressa.*

As currently defined the only differences between *E. compressa* and *E. acutisquamata* seem to be that *E. compressa* has distinctly compressed culms and is mostly eastern, whereas *E. acutisquamata* has subterete culms and occurs mostly in the Great Plains. Svenson (1966, Appendix herein) stated that *E. acutisquamata* should be included under *E. compressa.*

However, my studies show that there are two groups of specimens that have been included within *E. compressa* and *E. acutisquamata* but clearly deserve species status. These groups differ strikingly from both typical *E. acutisquamata* and *E. compressa* and from each other. In these two groups the proximal scale and all of the floral scales are bifid, and the rhizomes and their scales are obscured by the living and dead culm bases. In contrast, in both typical *E. acutisquamata* and typical *E. compressa* the proximal scale of the spikelet is entire and the floral scales vary from bifid to entire, often in the same spikelet, and the rhizomes and their scales are clearly evident, not obscured by culm bases. One of these groups, which has been included in *E. compressa,* has extremely broad, compressed culms, and is known only from Tennessee and adjacent Georgia, Alabama, and Kentucky; it is herein described as *E. bifida.* The other group, which has been included in *E. acutisquamata,* has very slender, subterete culms and is known only from Texas and Oklahoma; it is herein described as *E. occulta.* The remaining plants comprise an extremely morphologically variable group within which it is impossible to clearly distinguish segregate taxa. A satisfactory treatment of these remaining plants is to combine them under *E. compressa* with two varieties as is accomplished herein.

1. **Eleocharis elliptica** Kunth var. **atrata** (Svenson) S. G. Smith, stat. nov. Basionym: *Eleocharis compressa* var. *atrata* Svenson, Rhodora 34: 218. 1932. *Eleocharis elliptica* forma *atrata* (Svenson) Drapalik & Mohlenbrock, Amer. Midl. Naturalist 64: 20. 1960. *Eleocharis tenuis* var. *atrata* (Svenson) Boivin, Provancheria 25: 63. 1992. TYPE: U.S.A. Pennsylvania: Presque Isle, Erie, 18 June 1910, *A. S. Pease 12881* (holotype, GH).

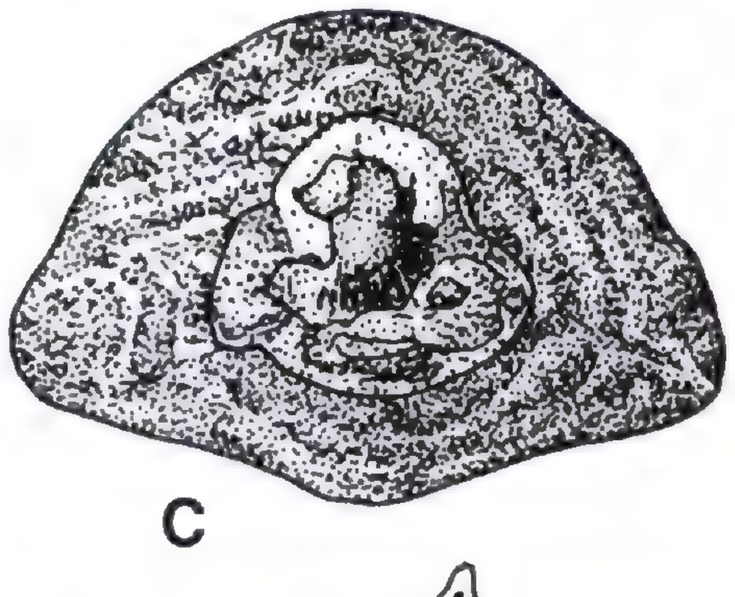
The type is complete, with rhizomes and many mature achenes. It approaches *E. compressa* var. *compressa* in its stout rhizomes with very short internodes, slightly compressed culms (ca. 1.2–2× wider than thick) with up to 8 prominent ridges, and its floral scale apices cut ca. 0.5–0.7 mm deep. However, it is much more like *E. elliptica* in its achenes and tubercles as well as in the presence of a stout tooth on many distal leaf sheath summits.

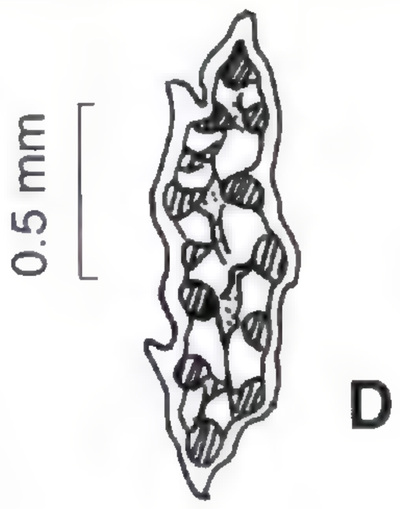
My field observations in Wisconsin indicate that typical *E. elliptica* grows in permanently wet habitats such as those found in many groundwater discharge areas in fens, whereas *E. compressa* grows in places such as depressions in prairies and exposed limestone that are often dry in summer. *Eleocharis elliptica* var. *atrata* grows in such habitats as the drier parts of fens that are intermediate between those of typical *E. elliptica* and those of *E. compressa.*

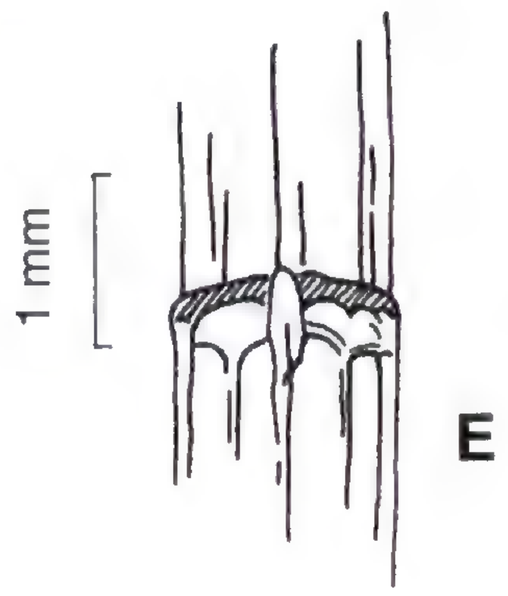
2. **Eleocharis bifida** S. G. Smith, sp. nov. TYPE: U.S.A. Tennessee: Wilson Co., industrial park development just S of Hwy. 40 on E side of Lebanon, disturbed limestone glade, 19 May 1992, *S. G. Jones & R. Kral 8684* (holotype, TENN; isotypes, MICH, SAT, USF, VSC). Figures 1, 2.

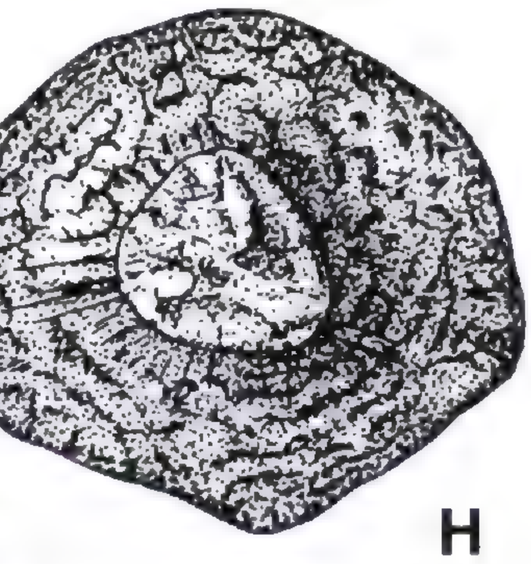
Species *E. compressae* affinis sed rhizomatibus culmis tectis, (3–)4–5 mm crassis, culmis compressis magnopere 4–10-plo latis quam crassis, stylis omnibus trifidis, fructibus omnibus trigonis teretis fere vel compressis leviter differt.

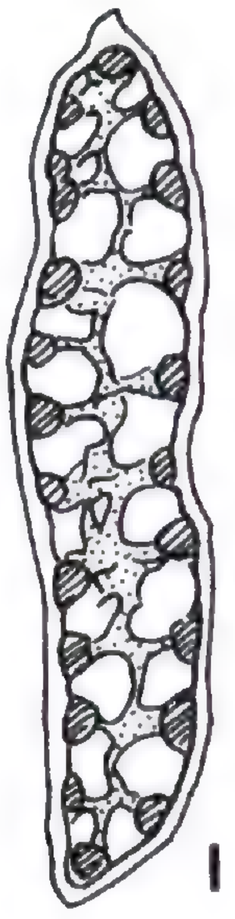
Densely caespitose; (8–)20–35 cm. *Rhizomes* concealed by living and persistent dead culm bases, short; (3–)4–5 mm thick; hard; internodes too short to measure; scales decaying to coarse fibers, ca. 1 cm, papery, fibrous. *Culms* greatly compressed, cross section narrowly oblong, ca. 4–10× wider than thick, often with 1 or 2 sharp ridges on one side; 0.7–2.3 mm wide; hard; finely striate; internally spongy. *Distal leaf sheaths* persistent, not splitting; proximally red or stramineous, distally green to stramineous; papery; summits inflated, dark brown, callose; apices broadly obtuse to subtruncate; tooth absent. *Spikelets* ovoid, acute; 4–9 × 2.5–4 mm. All *scale* apices bifid. *Proximal scale* without a flower, clasping ca. 2/3–3/4 of culm. *Subproximal scale* with or without a flower. *Floral scales* spreading in fruit; ca. 30 to 60, 6 to 9 per mm of rachilla; medium or pale brown, midrib region often narrowly paler; ovate-lanceolate; carinate in distal part of spikelet; 2.5–3.5 × 1.5 mm. *Perianth bristles* 0(to 5); stramineous to pale brown; ca. half of to equaling achene, densely to sparsely retrorsely spinulose. *Stamens* 3; anthers orange-brown, ca. 0.7–1.5 mm, apices apiculate. *Styles* all trifid. *Tubercles* brown; depressed-pyramidal, often rudimentary; 0.1–0.25 × 0.2–0.3 mm. *Achenes* falling with scales; dark yellow when unripe, yellow- to medium

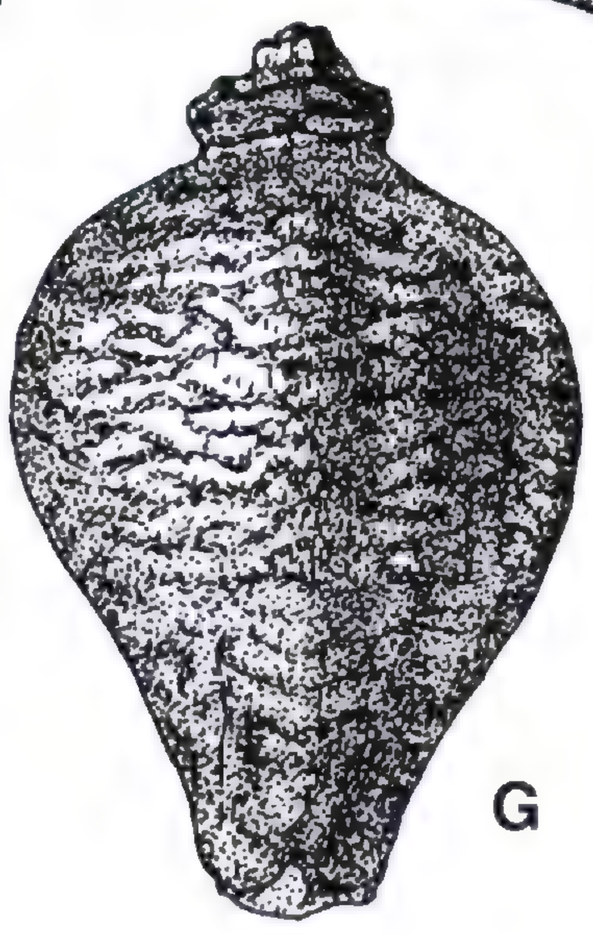












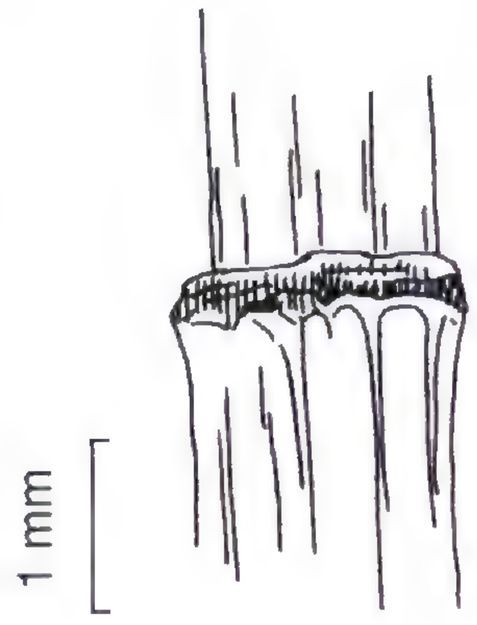


Figure 1. A–E, *Eleocharis compressa* Sullivant var. *compressa*. —A. Spikelet. —B, C. Achenes. —D. Culm cross section. —E. Distal leaf sheath summit. F–J, *Eleocharis bifida* S. G. Smith. —F. Proximal part of spikelet. —G, H.

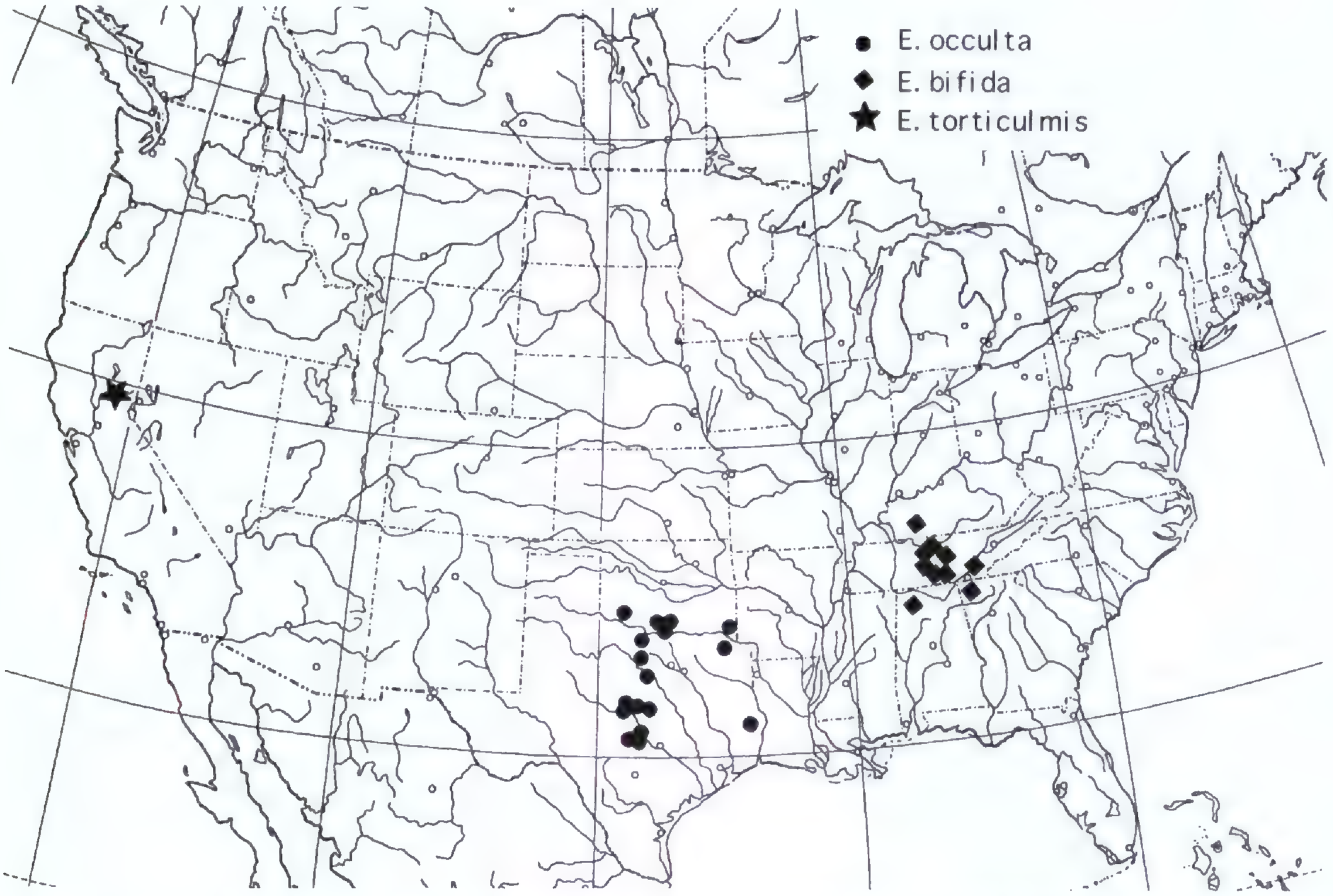


Figure 2. Known distribution of *Eleocharis bifida* S. G. Smith (diamonds), *Eleocharis occulta* S. G. Smith (circular dots), and *E. torticulmis* S. G. Smith (star).

brown when ripe; obovoid to obpyriform, neck usually very short; trigonous, nearly terete to slightly compressed, angles obscure or evident; 0.9–1.1 × 0.6–0.75 mm; finely rugulose at 10–30×, with 20 or more low, blunt horizontal ridges in a vertical series.

Distribution and ecology. *Eleocharis bifida* is currently known only from Tennessee, Alabama, Georgia, and Kentucky (Fig. 2). Its typical habitat as given on collection labels is seeps and other wet places in forest openings ("barrens" or "glades") on limestone. The label of *Svenson 13059* from Montgomery Co. states: "clumps in wet meadow with *Eleocharis wolfii, E. tenuis* var. *verrucosa, E. tenuis* var. *pseudoptera, Carex shortiana.*" The label of the type specimen states: "disturbed limestone glade with calcareous clay soil and limestone, with *Carex, Penstemon, Dalea, Sphenopholis, Euphorbia, Bromus, Melica* and *Juncus.*" The label of *Svenson 7148* from Wilson Co. states: "dried-out beds of shallow streams." Other habitats given are prairie, roadside ditch, and rocky pasture. The only reported elevation I have seen is ca. 200 m. Flowering and fruiting are in May and June.

The epithet *bifida* describes the bifid spikelet scales, including the proximal scale.

Eleocharis bifida has previously been included in *E. compressa*, which differs (as defined below) consistently and qualitatively as follows (refer to Figs. 1 and 3): *Rhizomes* evident, not obscured by culm bases rather than obscured (as in *E. occulta*, Fig. 3). *Proximal scales* of spikelets entire. *Eleocharis compressa* also differs, with some overlap of measurements or character states, as follows: *Rhizomes* 2–3 mm thick, internodes to 2 mm. *Culms* (0.3–)0.5–1.5 mm wide, ca. 1–5× wider than thick when dry, usually with prominent sharp ridges. *Floral scales* usually bifid in the proximal half and entire in the distal half of the spikelet, less commonly all bifid, rarely all entire. *Styles* often trifid and bifid in the same spikelet. *Achenes* compressed-trigonous or often some biconvex in the

←

Achenes. —I. Culm cross section. —J. Distal leaf sheath summit. A, drawn from *Monson 1886* (ISC); B, drawn from *Correll & Correll 37307* (LL); C, drawn from *Clokey 2375* (WIS); D, drawn from *Mackenzie s.n.*, Sussex Co., N.J. (NY); E, drawn from *Clokey 2375* (NY); F, drawn from *Busing 80-158* (TENN); G, H, and J, drawn from *Kreibel 9850* (NY); I, drawn from *McNeilus 88-518* (WIS).

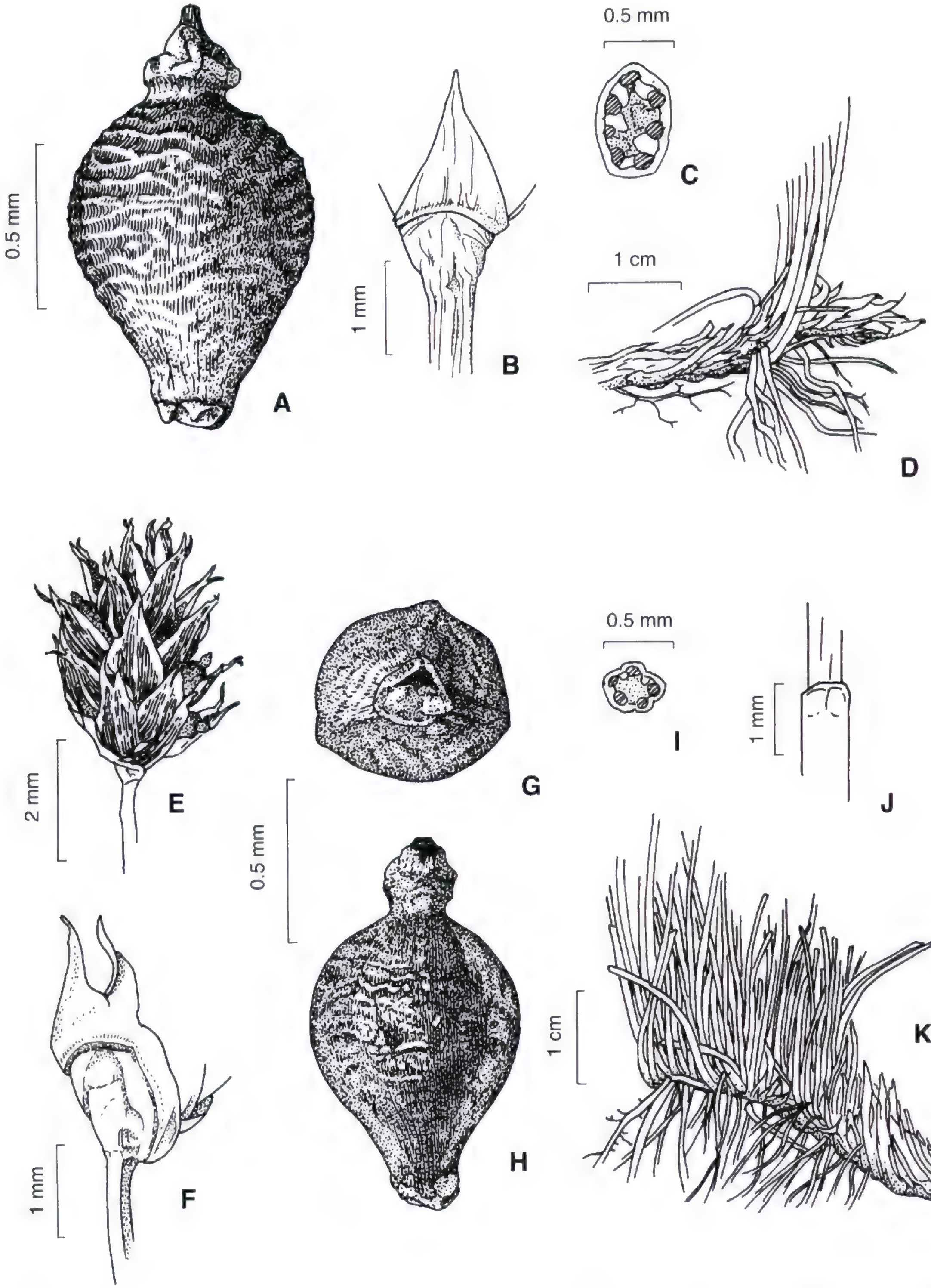


Figure 3. A–D, *Eleocharis compressa* Sullivant var. *acutisquamata* (Buckley) S. G. Smith. —A. Achene. —B. Proximal scale of spikelet. —C. Culm cross section. —D. Rhizome and proximal part of culm tuft. E–K, *Eleocharis occulta* S. G. Smith. —E. Spikelet. —F. Proximal scale of spikelet. —G, H. Achenes. —I. Culm cross section. —J. Distal leaf sheath summit. —K. Portion of rhizome and proximal part of culm tuft (at left). A, drawn from *Correll & Correll 37307* (LL); B to D, drawn from *Lundell 13663* (LL); E and G to I, drawn from *Bridges & Kindscher 13591* (LL); F, drawn from *Oefinger 355* (TEX); J and K, drawn from *Lundell & Lundell 10298* (LL).

same spikelet, the abaxial angle evident or lacking, usually finely rugulose at 10× (20×).

Eleocharis bifida is morphologically very constant, whereas *E. compressa* is highly variable. A few specimens from similar habitats in Tennessee and adjacent Alabama and Kentucky resemble *E. bifida* except for their entire proximal spikelet scales and/or evident rhizomes. *Eleocharis bifida* is known only from south of the limits of Pleistocene glaciation, whereas *E. compressa* occurs mostly in glaciated regions.

Paratypes. U.S.A. **Alabama:** Franklin Co., seepage area on cedar glade 1 mi. N of Richardson's Crossing, ca. 7 mi. E of Russelville, 1961, *E. E. Terrell & A. S. Barclay 3503* (FSU). **Georgia:** Catoosa Co., Chickamaugua Natl. Battlefield Park, 20 mi. N of Viniard, 1990, *D. F. Brunton & K. L. Mcintosh 9587* (MICH). **Kentucky:** Logan Co., limestone glade on Lula Davis farm 0.8 mi. on Duncan Chapel Rd. from US 68E, 1977, *R. Athey 3730* (FSU). **Tennessee**: Coffee Co., prairie 4 mi. SE of Manchester, 1947, *R. E. Shanks et al. 5184* (TENN); Davidson Co., Mt. Juliet Rd., 4.8 mi. S of I-40, Couchville Barrens, 1988, *V. E. McNeilus 88-518* (FLAS, NDA, TENN, WIS); along Nashville Rd. near Lavergne, cedar glades, 1938, *H. K. Svenson 8712* (CAS, GH, MO, NY, TENN, WIS); Davidson Rd. ca. 5 mi. W of Nashville, 1942, *J. M. Shaver 2587* (BRIT, TENN); Marshall Co., 2.1 mi. ESE of Pottsville on Tenn. Rte. 99, limestone glade, 1969, *R. Kral 34780* (MO); along Tenn. Rte. 99 ca. 2.0 mi. W of Rte. 31A, 1998, *V. E. McNeilus 98-212* (TENN); Maury Co., open glade 1.8 mi. W of Bryant Station along Tenn. Rte. 50, SE of Columbia, 1966, *R. Kral 26697* (KANU); Meigs Co., jct. of Tenn. Rte. 58 & 60, 1992, *V. E. McNeilus 92-518* (FLAS, LSU, MICH, NDA, TENN, WIS); barren at NW corner of jct. of Tenn. 58 & 60, 1987, *H. R. DeSelm s.n.* (TENN); Montgomery Co., King-Queen Bluff on Cumberland River 3 mi. ESE of Clarksville, 1950, *A. Clebsch 12915* (TENN); Rutherford Co., Murphfreesboro, S side of East Clark Blvd., 1954, *H. K. Svenson 13059* (TENN, WIS); limestone barren opposite Stones River, Mil. Park, N of Murphfreesboro, 1959, *A. J. Sharp 25892* (TENN); U.S. Hwy. 231 W of Christiana, 1959, *A. J. Sharp 25915* (TENN); Sharp's Barren opposite entrance to Stone's River Military Park NW of Murphfreesboro, 1958, *H. R. DeSelm 1776* (TENN); roadside ditch along Rd. 10 about 10 mi. N of Murphfreesboro, 1941, *C. C. Deam 61392* (KANU); Wilson Co., Cedars of Lebanon Park, Vine Quadrangle, 3.75 mi. W of U.S. Hwy. 231, 1980, *W. Manek 12* (TENN); cedar glades 7 mi. N of Murphfreesboro, 1942, *R. M. Kriebel 9850* (NY); E side of Rd. 10, 11 mi. S of Lebanon, 1941, *R. M. Kriebel 9452* (NY); Lebanon State Forest near Cedars of Lebanon State Park, E of U.S. Rte. 231, 1995, *S. R. Hill 26246* (ILLS, USF); cedar glade along Cedar Forest Rd., 2.0 mi. W of U.S. Hwy. 231, Vine Quadrangle, 1980, *R. Busing 80-158* (TENN); Sinking Creek, S side of Lebanon, 1969, *K. E. Blum 3414* (TENN); N side of county road ca. 2 mi. E of Vesta and 4 mi. SE of Gladeville, 1977, *D. H. Webb et al. 884* (TENN); Cedars of Lebanon Forest rd. ca. 1.8 mi. W of Rte. 231, 1990, *V. E. McNeilus 90-235* (NDA, TENN, WIS); limestone barrens near Gladeville, 1960, *F. A. Swink 3385* (F).

3. Eleocharis occulta S. G. Smith, sp. nov. TYPE: U.S.A. Texas: Montague Co., just W of Forestburg, in water in edge of small pond, in clumps, 28 Apr. 1964, *D. S. & H. B. Correll 29501* (holotype, LL; isotype, GH). Figures 2, 3.

Species *E. compressae* Sullivant et *E. acutisquamatae* Buckley affinis sed rhizomatibus culmis tectis, culmis teretibus, squamis spicularum omnibus bifidis, stylis omnibus trifidis, fructibus omnibus trigonis, teretis fere, rugulosis obscure differt; ab *E. bifida* culmis teretibus, squamis spicularum 2–2.8 mm longis, circa 1 mm latis, apicibus lanceolatis-attenuatis differt.

Densely caespitose; 27–56 cm. *Rhizomes* concealed by living and persistent dead culm bases, often ascending, short; 3–5 mm thick; hard; cortex persistent; internodes very short; scales decaying to coarse fibers, ca. 5–12 mm long, papery. *Culms* subterete, sometimes slightly compressed, with 4 to 7 blunt ridges when dry; 0.2–0.5(0.7) mm wide; firm to hard; spongy. *Distal leaf sheaths* persistent, not splitting; proximally red, distally green to stramineous; thinly papery to thinly membranous, sometimes hyaline; summits often inflated, often callose; apices broadly obtuse to subtruncate; sheath tooth absent. *Spikelets* ovoid, acute; 3–10 × 2–3 mm. All *scale* apices bifid. *Proximal scale* amplexicaulous. *Floral scales* deciduous, spreading in fruit; ca. 20 to 50, with 7 per mm of rachilla; medium brown, midrib region often narrowly stramineous; apices lanceolate-attenuate; carinate; 2.0–2.8 × ca. 1 mm. *Perianth bristles* 3 or absent, stramineous to pale brown, rudimentary to about half of achene, sparsely obscurely retrorsely spinulose. *Stamens* 3, anthers orange-brown, thecae 0.7–1.3 × 0.25 mm, apex acute. *Styles* trifid. *Tubercles* brown, depressed-pyramidal, often rudimentary; 0.1–0.15 × 0.2 mm. *Achenes* falling with scales, dark yellow ripening to medium or dark brown, obpyriform, neck distinct, rarely absent; obscurely trigonous, nearly terete; 0.7–1.0 × 0.5–0.65 mm; obscurely rugulose at 10–30×, 30 or more low, blunt horizontal ridges in a vertical series.

Distribution and ecology. *Eleocharis occulta* is known only from Oklahoma and Texas (map, Fig. 2) but is expected from adjacent states. It flowers and fruits from March to May, sometimes as late as July. Reported habitats include seasonally wet seepages, depressions, swales, rock crevices, rocky streambeds, stream banks, wet meadows, pond margins, temporary pools, and juniper-oak glades, often on limestone (rarely granite) or evidently calcareous soils, the soils sometimes dry. Elevations reported

are ca. 75–325 m. Flowering and fruiting are in March to May.

The epithet *occulta* describes the hidden nature of the rhizomes, concealed by the culm bases. *Eleocharis occulta* was previously included in *E. acutisquamata*, the remainder of which is herein treated as *E. compressa* var. *acutisquamata*.

Eleocharis compressa consistently and qualitatively differs from *E. occulta* as follows: *Rhizomes* not hidden by culm bases (Fig. 3). *Proximal scale* of spikelets entire (Fig. 3). *Eleocharis compressa* inconsistently differs, with some overlap of character states, as follows: *Rhizome* internodes to ca. 2 mm. *Culms* often greatly compressed, to 1.8 mm wide and 5× wider than thick. *Floral scale apices* usually bifid or deeply cut toward spikelet base and merely bidentate or entire toward spikelet apex, sometimes all entire. *Styles* often trifid and bifid in the same spikelet. *Tubercles* often well developed. *Achenes* usually without a pronounced neck, commonly compressed trigonous or lenticular, angles usually evident, often clearly rugulose at 10–20×, ca. 14–20 rows of ridges in a vertical series.

Eleocharis occulta is morphologically very constant, whereas *E. compressa* is extremely variable. Like *E. bifida*, *E. occulta* occurs only south of the limits of Pleistocene glaciation, where it presumably survived glaciation in more or less its present range. Although *E. occulta* is sympatric with *E. compressa* var. *acutisquamata* throughout its range, no intermediates are known.

Paratypes. U.S.A. **Oklahoma:** Comanche Co., Wichita Mts., N slope of Elk Mountain, 1958, *L. M. Rohrbaugh 519* (KANU, OKL, OKLA); Wichita Mts. Natl. Wildlife Refuge, 1/2 mi. N of Grama Flat Lake, 1942, *F. B. Mc Murry 1150* (OKL); Wichita Mts. NWR Treasure Lake area, 1979, *C. Taylor 27414* (BRIT, TENN); Wichita Mts. NWR, Cado Lake, 1986, *L. K. McGrath & W. Wilson 16610* (OCLA); Wichita National Forest, Panther Creek, 1937, *C. T. Eskew 1626* (OKL); Hamilton Co., 7 mi. E of Hamilton, 1969, *J. W. Stanford 21* (OKLA); Johnston Co., Bee Branch ca. 5 mi. SW of Mill Creek, 1976, *J. Taylor 22082* (BRIT); McCurtain Co., limestone ridge 2 mi. E and 2 N of Idabel, 1969, *U. T. Waterfall 17434* (OKLA); Garvin 1936, *D. Demaree 12034* (OKL); Murray Co., near Crusher Spur, 1913, *G. W. Stevens 24* (BRIT, DS, GH, OKL, OKLA); Arbuckle Mts., ca. 3/4 mi. W of Camp Classen, 6 mi. S of Davis, 1948, *R. Stratton 6800* (CAS, NY, OKLA); below Arbuckle Dam, 1994, *F. L. Johnston et al. 0150* (OKL); Arbuckle Mts., Davis, 1936, *D. Demaree 12512* (OKL); Arbuckle Mts., R2E T1S Sec 30, 1.3 mi. SW of I-Hwy. 35 on U.S. Hwy. 77D, 1973, *R. J. Tyrl 746* (OKL, USF); near stream in Cowpen Canyon, Corbert Porphyry, 194[8?], *E. E. Dale 290* (OKL); near Honey Creek, Frank's Conglomerate, 1942, *E. E. Dale 87* (OKL); Rock Creek SW of Veteran's Lake, 1996, *B. Hoagland & D. Benish 0794* (OKL); Arbuckle Mts., Cow Pen Creek running through Frank's conglomerate, 1941, *M. Hopkins 5966* (OKL); Sulphur, Platt National Park, 1936, *D. Demaree 12250* (TEX); Pontotoc Co., Wintersmith Park 1 mi. S of Ada, 1952, *D. McCoy 2344* (OKLA). **Texas:** Blanco Co., Federales Falls State Park, 1992, *S. Oefinger, Jr. 355* (TEX); Little Blanco River 8 mi. S of Blanco, 1966, *J. R. Crutchfield 1206* (NY); Brown Co., 2 mi. W of Brownwood, 1968, *J. W. Stanford 2103* (OKLA); Hays Co., San Marcos, 1885, *N. T. Kidder s.n.* (KANU); Hamilton Co., seepy roadside ditch adjacent to prairie with limestone outcrops, ca. 11–12 mi. S of Hamilton, 1990, *E. L. Bridges & K. Kindscher 13591* (TEX); McCulloch Co., 4 mi. SE of Brady, 1963, *D. S. Correll, E. C. Ogden & H. K. Svenson 28259* (F, LL, NY, UC); McLennan Co., Hog Creek, 1947, *L. D. Smith 473* (TEX); Red River Co., White Rock, 1963, *D. S. Correll 27268* (LL, UC); San Augustine Co., 1.1 mi. E of center of San Augustine, 0.2 mi. SW of gravel road to Sunrise, 1988, *S. L. Orzell & E. L. Bridges 6871* (TEX); about 1 mi. SW of San Augustine, 1962, *D. S. Correll 25004* (LL, NY 2 sheets); road to S of Rte. 21 at E edge of San Augustine, 1964, *D. S. & H. B. Correll 29081* (LL); San Saba Co., 14 mi. SW of Richmond Springs, 1977, *P. Burleson 744* (SAT); Tarrant Co., main road 0.8 mi. SE of N gate, Natl. Guard Eagle Mountain Lake Training Area, Avondale Quadrangle, 1993, *W. R. Carr 12802* (TEX); Travis Co., Edwards Plateau near Austin, 1921, *B. C. Tharp s.n.* (UC); 14 mi. W of Austin, 1921, *B. C. Tharp 995* (GH, NY), 1921, *B. C. Tharp 996* (F, ISC, NY); ravine between Cypress and Sandy Creeks up the Colorado River, Austin, 1921, *B. C. Tharp 998* (CAS, TEX); temporary pool, upper end of Lake Austin, 1946, *M. Wheeler et al. 16T229* (TEX); seepage along upper Bull Creek, 1946, *J. Adamcik & F. A. Barkley 16T205* (F, GH, TEX); hills W of Austin, Common Ford Rd. ca. 1 mi. N of Bee Cave Rd. (Rt. 2244), 1983, *B. Ertter & M. Baker 4816* (CAS, NY, WIS); North Cat Mountain, N of Valburn Drive from Valburn Circle N., 1991, *R. Kral & S. Jones 78655* (MO, TENN); Colorado River, Austin, 1936, *B. C. Tharp s.n.* (CAS); west of Austin near Beecaves, 1941, *C. L. & A. A. Lundell 10289* (LL); Travis [Trinity?] Co., Onion Creek, 1930, *B. C. Tharp s.n.* (F, GH, NY, UC); Williamson Co., 1946, *E. J. Dyksterhuis et al. s.n.* (TEX); Wise Co., Denton-Decatur Rd., 1940, *C. L. & A. A. Lundell 8461* (LL, MICH).

4a. Eleocharis compressa Sullivant, Amer. J. Sci. 42: 50. 1842; var. **compressa**. *Eleocharis elliptica* Kunth var. *compressa* (Sullivant) Drapalik & Mohlenbrock, Amer. Midl. Naturalist 64: 20. 1960. TYPE: U.S.A. Ohio: wet places in the Darby Plains, 15 mi. W of Columbus, 1840?, *W. S. Sullivant s.n.* (holotype, NY; isotype, WIS).

The holotype is a complete specimen including a clearly visible scaly rhizome similar to that of *E. compressa* var. *acutisquamata* (Fig. 3D). The floral scale apices are clearly bifid (Fig. 1A), not simply split during development or lacerated by wear. Because the apices of the proximal scales of the spikelet are worn or hidden underneath the mounted spikelets, their form is not clearly observable. There is only one achene on the holotype and several on the isotype at WIS. There are also four possible isotypes at NY.

The type fits Sullivant's description in the protologue of *E. compressa* as having "deeply 2-cleft" floral scale apices. Later authors, however, stated that the scales are "commonly bifid" (Svenson, 1932, 1957) or only "lacerate in age" (Gleason, 1968). My observations of specimens that Svenson assigned to *E. compressa* show that the floral scale apices vary from all deeply bifid to all entire, often in the same spikelet (see Fig. 1A).

The earlier name *Eleocharis acuminata* (Muhlenberg) Nees [in Linnaea 9: 294 (1834), basionym *Scirpus acuminatus* Muhlenberg in Descr. Gram.: 27 (1817)], was given as a synonym of *E. compressa* in Index Kewensis (Trustees of the Royal Botanic Gardens, Kew, 1: 829 and version 2.0 (1997)) as well as in several later databases (TROPICOS, Missouri Botanical Garden, 2001; International Organization for Plant Information, 2000; USDA, NRCS, 2001; *Synthesis of the North American Flora* [but questioned with ?], Kartesz & Meachum, 1999), but it should be treated as a *nomen confusum* pending further study and typification (Svenson, 1932: 217).

Eleocharis compressa and *E. acutisquamata* Buckley are here combined because they constitute a single, morphologically extremely variable complex within which species cannot be clearly distinguished. *Eleocharis compressa* var. *compressa* (Fig. 1A–E) as here defined differs from *E. compressa* var. *acutisquamata* (Fig. 3A–D) mainly in the cross-section shape (and width) of the culms, which are about 2–5× as wide as thick and 0.5–1.8 mm wide in *E. compressa* var. *compressa*, but terete to about twice as wide as thick and 0.2–1 mm wide in *E. compressa* var. *acutisquamata*. *Eleocharis compressa* var. *compressa* is known mainly from the tall-grass prairie region, whereas *E. compressa* var. *acutisquamata* is known mainly from farther west in the Great Plains.

In the specimens that Svenson identified as *E. compressa* or *E. acutisquamata*, the floral scale apices vary from all deeply bifid to all entire as well as from narrowly attenuate to merely acute; the culms vary from all terete to some or all distinctly compressed; the styles are often trifid and bifid in the same spikelet; and the achenes vary from nearly equilaterally trigonous to biconvex, often in the same spikelet. This variation strongly suggests hybridization with *E. erythropoda* (as reported from Ontario by Catling, 1994), *E. elliptica*, *E. macrostachya*, and perhaps *E. montevidensis*, which are all partly sympatric with *E. compressa*. I have observed putative *E. compressa* ×*elliptica* and *E. compressa* ×*erythropoda* hybrids in calcareous fens and degraded wet prairies in southeastern Wisconsin.

4b. Eleocharis compressa var. **acutisquamata** (Buckley) S. G. Smith, stat. nov. Basionym: *Eleocharis acutisquamata* Buckley, Proc. Acad. Nat. Sci. Philadelphia 1862: 10. [1863.] TYPE: U.S.A. Texas: San Saba Co., *Buckley s.n.* (holotype, PH).

The label on the type reads only "E. acutisquamata Buckl. San Saba," which is on the Edwards Plateau ca. 80 mi. NW of Austin. The type consists of a single tuft with about 2 mm of rhizome and several fruiting spikelets. Its culms are subterete, mostly with ca. 5 to 6 blunt ridges when dry. Most floral scales are acuminate and entire, with a few shallowly bidentate. The type is similar to many specimens I have identified as *E. compressa* var. *acutisquamata*.

In his 1863 protologue Buckley described *E. acutisquamata* as having culms filiform (thus presumably more or less terete) and scales acute. The type fits this description except that most floral scale apices are attenuate, and the scales in about the proximal half of the spikelet are shallowly bidentate. Svenson (1957) described the scale apices as "acute to acuminate," and Correll and Correll (1972) described them as "long-attenuate sometimes bifid (split) acute."

Index Kewensis [Jackson, 1893, 1: 830] erroneously gave *E. acutisquamata* as a synonym of *E. palustris*.

The unpublished chromosome count of "n = 12; 2n = 24 (taken from mitotic MC)" that is given on the label on the following specimen of *E. compressa* var. *acutisquamata* is the only count for *E. compressa* that I have verified by a voucher: U.S.A. Kansas: Trego Co., Cedar Bluff Reservoir, sandy lake shore, 16 June 1964, *L. J. Harms 2419* [labeled *E. compressa*] (KANU).

C. *Eleocharis* Subgenus *Zinserlingia* T. V. Egorova

Eleocharis subg. *Zinserlingia*, segregated from series *Pauciflorae* Svenson (1929), is amply distinct from other groups of *Eleocharis* and is probably monophyletic (Gonzalez-Elizondo & Peterson, 1997; Gonzalez-Elizondo et al., 1997; Roalson & Friar, 2000). It is technically defined mainly by the proximal internodes of the rachillae thicker and shorter than internodes in the middle of the spikelet, whereas in the rest of the genus the internodes are all about the same thickness and length. All of the North American species are very similar in both vegetative and sexual reproductive characters. The group ranges widely in North America and Eurasia and is disjunct in the Andes of temperate South

America. It comprises perhaps eight species and is much in need of a worldwide taxonomic revision. I recognize the following four species for North America: (1) *E. quinqueflora* (F. X. Hartman) O. Schwarz; (2) *E. suksdorfiana* Beauverd [= *E. quinqueflora* var. *suksdorfiana* (Beauverd) Hultén]; (3) *E. bernardina* (Munz & I. M. Johnston) Munz & I. M. Johnston [= *E. quinqueflora* var. *bernardina* (Munz & I. M. Johnston) Gonzalez-Elizondo & P. M. Peterson]; (4) *E. torticulmis* S. G. Smith (described herein). The characteristics of these species are summarized in Table 1.

Eleocharis quinqueflora was long known as *E. pauciflora* (Lightfoot) Link (described from Scotland) until O. Schwarz [in Mitt. Thüring. Bot. Ges. I: 89. 1949] adopted the name *E. quinqueflora* (also described from Europe) without explanation. Svenson (1929: 380) described *E. pauciflora* var. *fernaldii* for eastern North American plants mainly on the basis of less robust, softer plants, "scarcely indurated" caudices, and small differences in achenes and perianth bristles. Löve [in Svensk Bot. Tidskr. 48: 1: 380. 1954] raised variety *fernaldii* to species status because his chromosome count of $2n = 80$ was lower than counts of $2n =$ ca. 100 from Europe. Both *E. suksdorfiana* (1921) and *E. bernardina* (1925) were first described from North America as species. They were both reduced to varieties of *E. pauciflora* by Svenson (1934) because of perceived morphological intergradation, and later Svenson (1957) listed them as synonyms without comment. Hultén (1958) and Meusel et al. (1965) provided maps of *E. quinqueflora* s. str. (under *E. pauciflora*) and varieties for the Northern Hemisphere; they treated typical *E. pauciflora* as circumboreal and recognized *E. pauciflora* vars. *fernaldii* and *suksdorfiana* in North America as well as three other varieties in Eurasia. Hultén [in Ark. Bot. (n.s.) 7: 1: 24. 1968] and J. T. Howell [in Marin Flora, ed. 2, suppl.: 363. 1969] transferred *E. pauciflora* var. *suksdorfiana* to *E. quinqueflora* without comment, and Gonzalez-Elizondo and Peterson (1997) treated *E. bernardina* as *E. quinqueflora* var. *bernardina* because of perceived morphological intergradation.

As thus broadly defined *E. quinqueflora* is morphologically extremely variable. In contrast, my studies have shown that when different characters are used there are distinct morphological discontinuities, and four distinct species can be recognized for North America.

Eleocharis quinqueflora is circumboreal. In North America it includes *E. quinqueflora* subsp. *fernaldii* (Svenson) Hultén and two or three other undescribed intergrading variants that may deserve taxonomic recognition. Recognition of infraspecific taxa is premature pending a taxonomic revision of subgenus *Zinserlingia*. Although not mentioned in major European floras (Schulze-Motel, 1967; Walters, 1980), enlarged terminal overwintering buds, herein termed bulbs, that are similar to those commonly formed by North American plants were described and illustrated for Scandinavia by Strandhede and Dahlgren (1967) as typical of *E. quinqueflora*. These bulbs have fleshy food-storage modified leaves and tunicating papery scales, and plants that develop from them have bulbous culm-tuft bases with tunicating papery scales. Plants that form bulbs also lack hard, thick caudices. Pending a worldwide taxonomic revision, for North America I have assumed that the ability to produce bulbs and bulbous culm-tuft bases is characteristic of *E. quinqueflora* (see Table 1). With rare exceptions North American plants of *E. quinqueflora* also have a flower in the axil of the proximal scale of the spikelet.

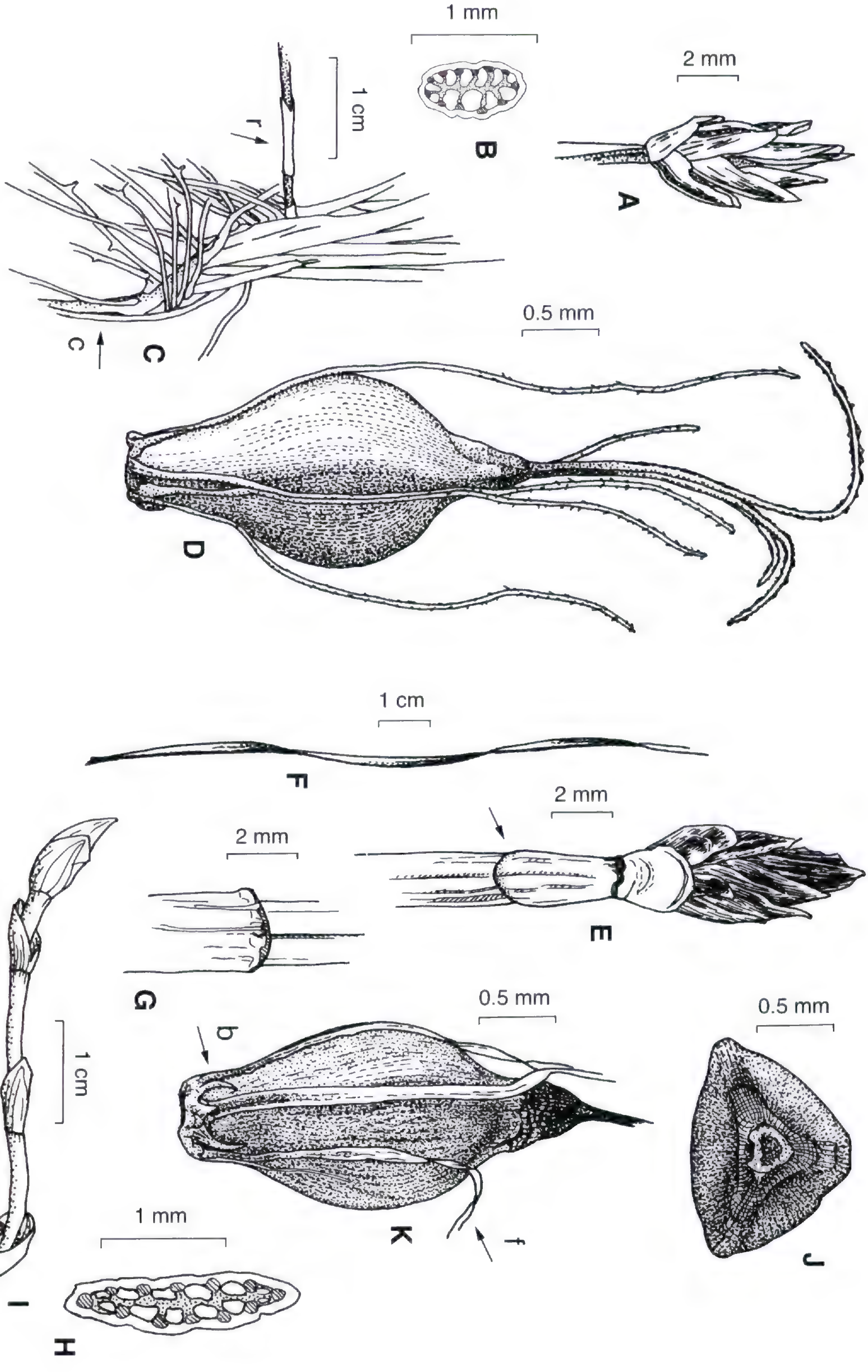
Eleocharis suksdorfiana, *E. bernardina*, and *E. torticulmis* are clearly closely related. They all differ from *E. quinqueflora* as here defined in the presence of well-developed caudices and the lack of underground bulbs or bulbous culm-tuft bases (see Table 1). Except for a few specimens of *E. suksdorfiana* these species also almost always lack a flower in the axil of the proximal scale. Based on my study of many specimens, including isotypes at GH, ISC, NY, and UC, I herein define *E. suksdorfiana* (see Table 1) differently from Svenson (1934) and Gonzalez-Elizondo et al. (1997), both of whom included plants with unusually large, ovoid bulbs. I place these large-bulbed plants in *E. quinqueflora*. Beauverd's (1921) fairly complete description closely matches the isotypes and all specimens I have identified as *E. suksdorfiana*, which is widely but locally distributed in western North America from near sea level to ca. 3300 m. *Eleocharis bernardina* is clearly closely related to *E. suksdorfiana* but differs qualitatively in several vegetative and perianth bristle characters as given in Table 1. It is very local in southern California.

A few specimens from a small area in northeastern California are clearly closely related to *E. suksdorfiana* and *E. bernardina* but consistently differ from them in several vegetative and perianth bristle characters (see Table 1). These specimens are described as a new species as follows:

1. **Eleocharis torticulmis** S. G. Smith, sp. nov. TYPE: U.S.A. California: Plumas Co., Northern Sierra Nevada, Crescent Mills Quadrangle, T25N R9E NE 1/4 SE1/4 sec. 20, N40°00′47″, W120°59′28″, Sweetwater Meadow in Butterfly Valley Botanical Area, *Darlingtonia* fen, elev. 1177 m, 3 July 2000, *L. P. Janeway & B. Castro 6874* (holotype, JEPS; isotypes, CHSC, GH, MO, NY, OSC, RSA, US, WIS). Figures 2, 4.

Table 1. Distinguishing characteristics of the North American species of *Eleocharis* subg. *Zinserlingia*.

	E. quinqueflora	*E. bernardina*	*E. suksdorfiana*	*E. torticulmis*
Rhizome thickness	0.2–1 mm	0.5–1 mm	0.5–1.5 mm	1.5–2 mm
Underground and basal bulbs	often present	absent	absent	absent
Caudices	absent or soft, to 0.5 mm thick	present, hard, 1–2 mm thick	present, hard, 1–2 mm thick	present, hard, 3 mm thick
Culm tuft bases	often bulbous and tunicated with scales	never bulbous or tunicated with scales	never bulbous or tunicated with scales	never bulbous or tunicated with scales
Culm habit	erect, not spirally twisted	markedly arched, not spirally twisted	erect, not spirally twisted or slightly so	erect, markedly spirally twisted
Culm cross section	subterete to slightly compressed, to ca. 2× wider than thick	subterete to slightly compressed, to ca. 2× wider than thick	subterete to slightly compressed, to ca. 2× wider than thick	greatly compressed, ca. 3–4× wider than thick
Culm width	0.2–0.5 (–1.2) mm	0.5–1 mm	0.5–1.2 mm	1.5–2.5 mm
Culm contraction	not contracted	not contracted	not contracted	obliquely contracted proximal to spikelet
Proximal scale flower	absent or rarely present	absent	absent or rarely present	absent
Perianth bristle number	ca. 3–6	ca. 4–7	6	1 to ca. 5 or apparently absent
Perianth bristle dimensions and indument	variable, often unequal, rudimentary to equaling tubercle, stout to slender, smooth to densely spinulose	unequal, less than half of to equaling achene, the shorter stout, smooth, the longer slender, densely spinulose	about equal, the longest equaling achene to exceeding tubercle, all slender, densely spinulose	unequal, rudimentary to ca. equaling achene, the shorter stout, smooth or nearly so, the longer slender, densely spinulose
Achene dimensions	1.6–2.3 × 0.7–1.3 mm	1.5–2.1 × 0.9–1.2 mm	1.7–2.3 × 0.7–1.3 mm	1.7–2.8 × 1–1.3 mm
Elevation	ca. 0–3600 m	2100–2700 m	ca. 10–3300 m	1200 m
Distribution	Circumboreal	Southern California	Western North America	Northeastern California


1 mm
1 cm
r
B
2 mm
A
0.5 mm
C
C
1 cm
D
E
2 mm
2 mm
G
F
0.5 mm
0.5 mm
1 cm
1 mm
H
K
J
L

Species *E. suksdorfianae* Beauverd affinis sed rhizomatibus 1.5–2 mm crassis, caudicibus 3 mm crassis, culmis tortis valde compressis magnopere 3–4-plo latis quam crassis contractis oblique circa 5 ad 40 mm spiculis proximе, perianthiis setis 3 brevissimis ad dimidium fructus interdum 1 vel 2 ad circa aequantibus tuberculis differt.

Perennial, 20–40 cm. *Rhizomes* ca. 7 cm × 1.5–2 mm; internodes ca. 1–2 cm; soft; cortex breaking loose, papery; central cylinder firm, tough; apical buds not enlarged or becoming bulbous, bulbs absent; scales ca. 7–9 mm, thinly papery, sometimes fibrous in age. *Scales (prophylls) among culm bases* brown, long-ovate, acute, ca. 13–20 × 6 mm, papery, often fibrous. *Caudices* vertical or ascending, short, hard, obscured by dead remains of culms, scales, and roots, ca. 3 mm thick. *Culms* in small tufts; tuft bases never bulbous or tunicated with scales; erect; markedly spirally twisted; obliquely contracted ca. 5–40 mm proximal to spikelet; greatly compressed, 1.5–2.5 mm wide, ca. 3–4× wider than thick when fresh; firm; nearly smooth or with up to 6 broad, rounded ridges on each side when dry, at 15–20× with many very fine ridges. *Proximal leaf sheaths* distally disintegrating, membranous-hyaline. *Distal leaf sheaths* persistent, not splitting ventrally, stramineous to gray or brown; papery; summits dark brown to reddish, subtruncate, ventrally truncate to shallowly concave, sometimes callose, apex broadly obtuse, without a toothlike rudimentary blade. *Spikelets* terete, oblong, acute to rounded, 6–8 × 2–3 mm. *Proximal scale* without a flower, amplexicaulous, broadly oval, entire, ca. 3–4 mm, mostly hyaline and colorless, proximally ca. 0.5–1 mm green or brown with dark brown margin and callose. *Subproximal scale* with a flower. *Floral scales* spiraled, appressed in fruit, ca. 8 to 10, ca. 2 per mm of rachilla; bright medium to chestnut brown or partly stramineous; oblong-ovate, apices rounded to acute, entire; 4–5.5 × ca. 2 mm; membranous; margins and apices very narrowly colorless and hyaline or like flanks; midrib obscure or evident. *Perianth bristles* 1 to ca. 5 or apparently absent, brown to stramineous, very unequal in same flower, 0.2–2.5 mm, the shorter stout, smooth or sparsely spinulose, the longer slender, densely spinulose, the spinules spreading, sharp to blunt, about as long as bristle width. *Stamens* 3, anthers pale yellow, thecae 1.8–3.0 × ca. 0.3 mm; connective extension brown, 0.5 mm, blunt to acute. *Styles* trifid about half of their length, ca. 6–8 mm, stigmas puberulent. *Tubercles* confluent with achene, usually clearly different from achene in color and texture, dark brown to stramineous, pyramidal, 0.25–6 × 0.3–0.55 mm. *Achenes* persistent with scales; stramineous to medium brown; obpyriform; thickly trigonous, angles prominent, rounded; ca. 1.75—2.75 mm long × 1.25 mm wide; usually distally narrowed into a stout beak that is stramineous to pale brown and ca. 0.3—0.6 mm long; usually finely reticulate at 10–20×, clearly to obscurely finely longitudinally ridged.

Distribution and ecology. *Eleocharis torticulmis* is known only from the type locality and immediate vicinity in Plumas Co., California (Fig. 2). Knight et al. (1970: 1–4) described the general ecology of the area in which the few collections have been made. All collections are from open wet meadows in mixed-conifer (mainly *Pinus ponderosa*) forest in the Arid Transition Zone at ca. 1180 m in the northern Sierra Nevada. Paleozoic marine sedimentary and metamorphic rocks dominate the area, rather than granite, which dominates the Sierra Nevada to the south, or volcanic rocks of the mountains a short distance to the north. Documents obtained by L. Janeway from the Plumas National Forest state that the 5-acre Butterfly Valley Botanical Area has folded metamorphic sedimentary and volcanic interlayered rock, and that groundwater and soil chemistry suggest a serpentine influence. Serpentine-based soils occur 3–4 miles to the west. As there are many serpentine-endemic plant species in California it is possible that *E. torticulmis* is endemic to serpentine soils.

The known habitat is gently sloping very wet to fairly dry places in spring-fed meadows, usually with a thin layer of sluggish sheet-flow water. At the type locality *E. torticulmis* was codominant in the peripheral parts of the meadow with *Rhynchospora capitellata* (Michaux) Vahl, *Hastingsia alba* (Durand) S. Watson, and *Juncus oxymeris* Engelmann, while *Darlingtonia californica* Torrey was dominant in the central part of the meadow with *Hastingsia alba, Narthecium californicum* Baker,

←

Figure 4. A–D, *Eleocharis suksdorfiana* Beauverd. —A. Spikelet. —B. Culm cross section. —C. Proximal part of culm tuft with part of caudex (c) and part of rhizome (r). —D. Achene with perianth bristles. E–I, *Eleocharis torticulmis* S. G. Smith. —E. Spikelet with part of culm showing oblique contraction (arrow). —F. Portion of culm, habit. —G. Distal leaf sheath summit. —H. Culm cross section. —I. Rhizome. —J, K. Achenes with stamen filaments (f) and very short perianth bristles (b). A, drawn from *Tracy 14220* (UC); B and D, drawn from *Janeway et al. 2499* (CHSC); C, drawn from *Oswald & Ahart 4793* (CHSC); E and G and I to K, drawn from *Janeway & Castro 6874* (TYPE); F, drawn from *Knight et al. 1772* (NY).

Tofieldia occidentalis S. Watson, and a little *E. torticulmis*. At the site of the *Ahart 8383* paratype, *E. torticulmis* was dominant in a wide band of very wet meadow around the pond extending to the dry margin of the pine forest, with scattered *Hastingsia alba*, *Carex echinata* Murray, and *Juncus oxymeris*. At the pond the dominance by *E. torticulmis* rapidly changes to dominance by *Carex vesicaria* L. At the upper edge of this very wet meadow, *E. torticulmis* occasionally gives way to more *Juncus oxymeris*, *Helenium bigelovii* A. Gray, *Mimulus primuloides* Bentham, *Platanthera sparsiflora* (S. Watson) Schlechter, and *E. suksdorfiana* (*E. suksdorfiana* vouchers: *Janeway & Castro 6875* (CHSC), *L. Ahart 8384* (CHSC), *J. Battagin s.n.* (CHSC), *W. & I. Knight & T. Howell 1537* (CAS)). At the only other meadow where *E. torticulmis* has been found, 1.1 km north of Butterfly Valley (*Janeway & Castro 6876* paratype), there is no standing water; *E. torticulmis* is almost hidden by the dominant *Juncus oxymeris*, and *Carex lemmonii* W. Boott, *C. feta* L. H. Bailey, *Triteleia hyacinthina* (Lindley) Greene, and *Sisyrinchium bellum* S. Watson are also common. The *W. & I Knight 1339* paratype of *E. torticulmis* from Butterfly Valley, however, is labeled "dry vernal area."

The collections made in 1966 bear very few mature achenes or flowers with anthers. The collections made in 2000 bear many mature achenes and flowers with exserted anthers, and many spikelets contain mature achenes proximally and flowers with exserted anthers distally. The more recent collections also bear actively growing rhizomes with apical buds forming new aerial shoots. No underground bulbs are known; overwintering is presumably by means of buds concealed among the culm bases and scales of the aerial shoots and caudices as in *E. suksdorfiana* and *E. bernardina*. Several of the specimens Knight et al. (1970) identified as *E. suksdorfiana* are *E. torticulmis*.

Eleocharis suksdorfiana differs from *E. torticulmis* consistently and qualitatively as follows (see Table 1): *Rhizomes* 0.5–1.5 mm thick; sprouting apical buds enlarged, ellipsoid, ca. 10 × 2–5 mm. *Caudices* ca. 1–2 mm thick. *Culms* erect; terete to slightly compressed, 0.5–1.2 mm wide, to ca. 2× wider than thick; slightly or not spirally twisted; not contracted subproximal to spikelets. *Perianth bristles* 6, all slender and spinulose, about equal, the longest about equaling the achene to exceeding tubercle. Widespread, ca. 10–3300 m elevation. *Eleocharis bernardina* differs from *E. torticulmis* consistently and qualitatively as follows (see Table 1): *Rhizomes* ca. 0.5–1 mm thick. *Caudices* ca. 1–2 mm thick. *Culms* strongly arched, not spirally twisted, not contracted subproximal to spikelets. *Perianth bristles* ca. 4 to 7, less than half of to equaling achene, the shorter stout, smooth, the longer slender, densely spinulose. Very local in southern California at 2100–2700 m.

The epithet *torticulmis* describes the markedly spirally twisted culms.

Paratypes. U.S.A. **California:** Plumas Co., head of small drainage to East Branch North Fork Feather River from the SE, vicinity of Paxton, ca. 1.1 km N of Butterfly Valley Botanical Area, open meadow with wet clayey soil but no water on the surface, with *Juncus oxymeris* dominant and *Carex lemmonii, C. feta, Triteleia hyacinthina*, and *Sisyrinchium bellum* also present, 3 July 2000, *L. P. Janeway & B. Castro 6876* (CAS, CHSC, MICH, NMSC); by small stream in bog, ca. 150 feet NW of pond, Butterfly Valley, ca. 5 air mi. NW of Quincy, bog in yellow pine forest, elev. 3300 ft., 21 May 2000, *L. Ahart 8383* (CHSC, JEPS, WIS); Butterfly Valley, near Pond Reservoir, 18 June 1966, *W. & I. Knight 1339* (CAS); Butterfly Botanical Area and vicinity, dry vernal area, Pond Reservoir, elev. 3600 ft., 26 July 1966, *W. & I. Knight & T. Howell 1394* (CAS); in profusion at north end of Pond Reservoir, elev. 3600 ft., 28 July 1966, *W. & I. Knight & T. Howell 1524* (CAS); Sweetwater Meadow, 28 July 1966, *W. & I. Knight & T. Howell* 1672 (CAS, NY); Sweetwater Meadow in Butterfly Valley Botanical Area, *Darlingtonia* fen (type locality), 13 Sep. 2000, *L. P. Janeway et al. 6969* (CHSC, JEPS, US); by little creek in Pond Meadow, 17 June 2000, *J. Battagin s.n.* (CHSC).

D. *Eleocharis* Subgenus *Scirpidium* (Nees) Kukkonen

Eleocharis subg. *Scirpidium* is comprised of about 12 species from Eurasia, North America, and South America. Although delimitation of species is sometimes difficult, this group is less troublesome than the other groups discussed herein. *Eleocharis acicularis* is circumboreal and quite variable. At first Svenson (1929) recognized four varieties and two forms in North America but later (1957) did not recognize infraspecific taxa. Most of the plants found within the regions of Pleistocene glaciation are very similar to typical *E. acicularis* (culms cylindric or 3- or 4-angled (see Fig. 5), distal leaf sheaths mostly obscure, tubercles about as high as wide, achenes about 2× longer than wide). South of the glaciated region, however, many plants have been placed in *E. acicularis* var. *occidentalis* Svenson (distinguished by plants only 2–8 cm tall, culm tuft bases often swollen, cormous, culms often 6- to 8-ribbed, distal leaf sheath summits often evident, inflated, tubercles usually depressed, achenes less than 2× longer than wide), and a few in *E. acicularis* var. *gracilescens* Svenson (distinguished by plants often tall, to 22 mm, culms smooth or sometimes finely 5- to 12-ridged, spikelets often linear-lanceoid, 4–8 mm long, floral scales often

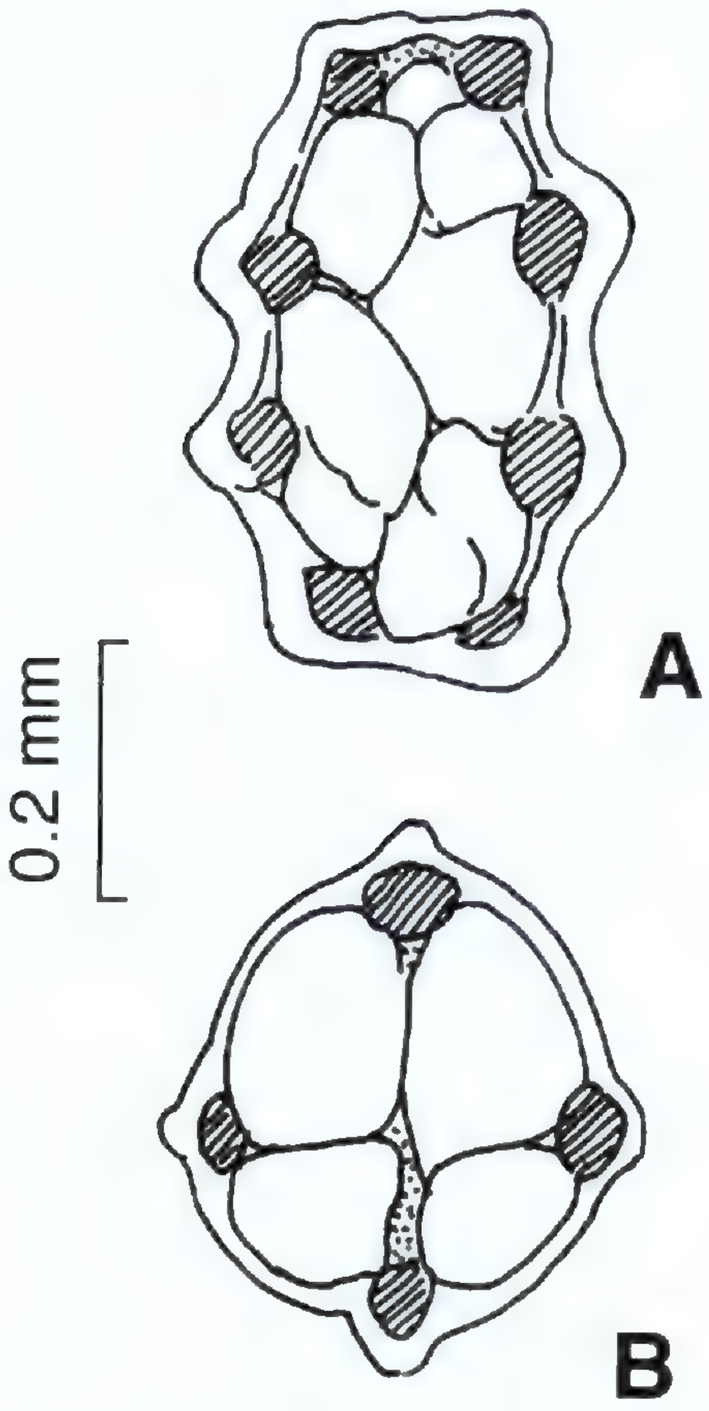


Figure 5. Culm cross sections. —A. *Eleocharis acicularis* (L.) Roemer & Schultes var. *porcata* S. G. Smith. —B. *Eleocharis acicularis* var. *acicularis*. A, drawn from *Correll & Correll 39584* (UC); B, drawn from *Fraser 493* (KSC).

stramineous, 2.5–3.5 mm long, achenes less than 2× longer than wide).

Some plants of *E. acicularis*, mostly from the Great Plains, do not fit any described variety. Because of their compressed, prominently ridged culms, these plants, including a paratype of *E. wolfii* (Illinois, 1861, *Elihu Hall s.n.*, GH), are sometimes misidentified as *E. wolfii*. The Hall collection was originally mounted on the same sheet as the holotype (Illinois, 1874, *John Wolf s.n.*, GH) of *E. wolfii*, but it was later separated along with a single tuft of *E. wolfii* (part of the type collection?) by cutting the sheet and filed in the general collection. In 1928 Svenson overlooked the several tufts of *E. acicularis* on the segregated sheet and annotated the Hall collection as *E. wolfii*. These confusing plants are here described as a new variety based primarily on their prominently ridged culms:

1. Eleocharis acicularis (L.) Roemer & Schultes var. **porcata** S. G. Smith, var. nov. TYPE: U.S.A. Texas: Dawson Co., playa 7 mi. W of Lamesa, near intersection of Farm Rd. 829 with U.S. 180, in clumps in mud, 9 May 1966, *D. S. Correll 32796* (holotype, NY; isotypes, KANU, LL). Figure 5.

Varietas ab *E. aciculari* var. *aciculari* foliis vaginis distalis apicibus persistentibus firmis, culmis plerumque manifeste compressis 6–12-porcatis differt; ab *E. aciculari* var. *occidentali* Svenson culmis basibus non tumidis, fructibus brevioribus differt.

Plants to ca. 22 cm tall. *Culms* 0.2–0.5 mm wide, at least some prominently 6- to 12-ridged, mostly distinctly compressed, usually firm, their bases not persistent and corm-like. *Distal leaf sheath summits* persistent, firm, usually inflated. *Spikelets* 3–7 mm long. *Floral scales* (1.5–)2–2.5 mm, flanks mostly bright orange-brown. *Perianth bristles* absent [rarely a few present?]. *Tubercles* depressed, ca. 0.05–0.1 long × 0.15–0.25 mm wide. *Achenes* less than 2× longer than wide, ca. 0.65–0.85 long × 0.5 mm wide, "neck" lacking (thus tubercle sessile).

Distribution and ecology. *Eleocharis acicularis* var. *porcata* is known from scattered localities in Canada: Alberta; and U.S.A.: Colorado, Illinois, Kansas, Nebraska, North Dakota, New Mexico, Texas, and Wyoming; at elevations from near sea level to at least 2200 m. Reported habitats are mud and very shallow water of fresh marshes, ponds, stream margins, prairie depressions, and ditches. Flowering and fruiting are from April (in southern Texas) to August.

This variety differs from all other known *E. acicularis* except variety *occidentalis* in the usually distinctly compressed culms, at least some culms on each plant with 6–12 prominent ridges (Fig. 5). It differs from variety *E. acicularis* var. *occidentalis* in its shorter achenes (0.85–1 mm in var. *occidentalis*) and the culm bases not persistent and corm-like. It morphologically intergrades with the other three varieties.

The epithet *porcata* describes the prominently ridged culms.

Paratypes. CANADA. **Alberta**: Bow River near Eau Claire sawmills, Calgary, 1948, *W. C. McCalla 10289* (ALTA); Stettler Area, Paintearth, 1974, *A. Klar 483* (ALTA); river near Kinninvic, 1927, *E. H. Moss 1184* (ALTA, NDA). U.S.A. **Arizona:** Cocconino Co., marsh below Black Spring, 7 mi. S of Flagstaff, 1966, *J. R. Crutchfield 1965* (NY); Cochise Co., Cooley's Ranch, 1912, *L. N. Gooding 1107* (NY). **Colorado:** Lincoln Co., 7 mi. S of Hall Station, 1937, *M. Ownbey 1321* (DS, GH, WTU); Weld Co., Ephemeral pond, Pawnee Natl. Grassland near Murphey Reservoir, 1995, *D. L. Hazlett 9168* (NY); Yuma Co., wheat field 2.5 mi. E of Yuma, 1973, *S. Stephens 65530* (KANU). **Illinois:** 1861, *E. Hall s.n.* (GH). **Kansas:** Cloud Co.: N of Jamestown, 1938, *S. V. Fraser 493*, (KSC); Saline Co., Ditch, Colby Branch Railroad N of Salina, 1943, *John Hancin 2448* (KSC); ditch, railroad N of Mulberry Creek bridge, 1931, *J. Hancin 950* (KSC). **Louisiana:** Tangipahoa Pa., railroad, Hammond, 1969, *C. J. Kirby 52* (LSU). **Nebraska:** Chase Co., prairie depression near Lamar, 1942, *W. L. Tolstead* 9925 (BRIT) [det. *E. wolfii*]; Hamilton Co., 6 mi. W of Aurora, 1944, *W. Keiner*

16770 (GH); Kearney Co., Minden, 1897, *H. Hapeman s.n.* (NMC). **New Mexico:** Colfax Co., vicinity of Ute Park, 1916, *P. C. Standley 13931* (GH); San Miguel Co., in 2–3 inches water, Laguna Huerfana, 8 mi. NW of Trujillo, 1965, *J. R. Crutchfield 418* (LL); 18 mi. E of Las Vegas, 1982, *S. R. Hill & P. -A. Levandoski 12043* (GH); Crystal Pasture, 9.5 mi. W of Trujillo, 1982, *S. R. Hill & A. D. Cress 1168* (GH). **North Dakota:** Burke Co., road ditches and farmland between Portal and Northgate road, 1969, *G. D. Hegstad 1398* (NDA); Mountrail Co., prairie, road ditch and slough S of Lower Lostwood Reserve, 1970, *G. D. Hegstad 5555* (NDA). **Texas:** Cameron Co., 20 mi. N of Brownsville, 1944, *Runyon 3679* (TEX); Wichita Co., Wichita Falls, 1926, *L. M. Kee 9158* (NY).

Acknowledgments. I thank especially Elizabeth Hollister Zimmerman, who made the drawings, mostly for publication in FNA; and Lawrence P. Janeway, who helped in many essential ways with *E. torticulmis* including collecting the type and a paratype, making the ecological field notes, obtaining other habitat information, and critically reading the manuscript. Victoria C. Hollowell and Anthony A. Reznicek critically reviewed the manuscript, and David F. Murray reviewed early versions. The curators of the following herbaria kindly loaned specimens and many were helpful during my visits: ALA, ALTA, ARIZ, BH, BHO, BKL, BRIT, CAS, CHSC, DAV, DS, F, FLAS, FSU, GH, ILL, ILLS, ISC, JEPS, KANU, KSC, KY, LL, LSU, MO, MT, NDA, NEBC, NLU, NMC, NMCR, NO, NY, OKL, OKLA, OCLA, OS, OSC, PH, POM, RSA, SASK, SIU, TENN, TEX, UBC, UC, UNAF, USF, UWL, V, WIS, WTU, WVA. The University of Wisconsin-Whitewater Biological Sciences Department provided essential space and other support. A grant from the Flora of North America Project defrayed many expenses.

Literature Cited

Boivin, B. 1979. Flora of the Prairie Provinces. A Handbook of the Provinces of Manitoba, Saskatchewan and Alberta. Provancheria 5. [Reprinted from Phytologia 42–43. 1979.]

Catling, P. M. 1994. *Eleocharis compressa* × *Eleocharis erythropoda*, a new natural hybrid spikerush from Ontario. Canad. J. Bot. 72: 837–842.

Correll, D. S. & H. B. Correll. 1972. Aquatic and Wetland Plants of Southwestern United States. Vol. 1. Environmental Protection Agency, U.S. Government Printing Office, Washington, D.C.

Drapalik, D. J. & R. H. Mohlenbrock. 1960a. The taxonomic status of *E. elliptica*. Amer. Midl. Naturalist 63: 143–148.

——— & ———. 1960b. *Eleocharis elliptica* and *E. compressa*: Further notes and corrections. Amer. Midl. Naturalist 64: 20.

Flora of North America Editorial Committee (editors). Flora of North America North of Mexico, Vol. 23, Cyperaceae. Oxford Univ. Press, New York and Oxford.

Gleason, H. A. 1968. The New Britton & Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. Hafner, New York and London.

——— & A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, ed. 2. The New York Botanical Garden, Bronx.

Gonzalez-Elizondo, M. & P. M. Peterson. 1997. A classification of and key to the supraspecific taxa in *Eleocharis* (Cyperaceae). Taxon 46: 433–449.

———, ——— & I. Granzow-de La Cerda. 1997. A cladistic and phenetic analysis of the *Pauciflorae* group of *Eleocharis* (Cyperaceae). BioLlania Edición Esp. No. 6: 341–368.

Harms, L. J. 1968. Cytotaxonomic studies in *Eleocharis* subser. *Palustres*: Central United States taxa. Amer. J. Bot. 55: 966–974.

———. 1972. Cytotaxonomy of the *Eleocharis tenuis* complex. Amer. J. Bot. 59: 483–487.

Hultén, E. 1958. Amphi-atlantic plants and their phytogeographic connections. Almqvist and Wiksell, Stockholm.

International Organization for Plant Information. 28 Nov. 2000. Provisional Global Plant Checklist (GPC) Database ver. 2.1. <http:\\IOPI.CSU.edu.au/uopi/>

Jackson, B. D. (compiler). 1893. Index Kewensis. Oxford Univ. Press, Oxford, England.

Kartesz, J. T. & C. A. Meachum. 1999. Synthesis of the North American Flora. CD-ROM, ver. 1.0. North Carolina Botanical Garden, Chapel Hill.

Knight, W., I. Knight & T. Howell. 1970. A vegetation survey of the Butterfly Botanical Area, California. Wasmann J. Biol. 28: 1–46.

Meusel, H., E. Jager & E. Weinert. 1965. Vergleichende Chorologie Zentraleuropaeischen Flora. Karten, 2 vols. Gustav Fischer Verlag, Gena.

Missouri Botanical Garden. 2001. TROPICOS Database, rev. 1.5. <http:\\mobot.mobot.org/W3T. . .> Missouri Botanical Garden, St. Louis.

Roalson, E. H. & E. A. Friar. 2000. Infrageneric classification of *Eleocharis* (Cyperaceae) revisited: Evidence from the internal transcribed spacer (ITS) region of nuclear ribosomal DNA. Syst. Bot. 25: 323–336.

Rolfsmeier, S. B. 1995. Keys and distributional maps for Nebraska Cyperaceae, part 1: *Bulbostylis, Cyperus, Dulichium, Eleocharis, Eriophorum, Fimbristylis, Fuirena, Lipocarpha,* and *Scirpus*. Trans. Nebraska Acad. Sci. 22: 27–42.

Schultze-Motel, W. 1967. *Eleocharis*. Pp. 52–67 *in* G. Hegi (editor), Illustrierte Flora von Mittel-europa. Verlag Paul Parey, Berlin-Hamburg.

Strandhede, S.-O. 1965. Chromosome studies in *Eleocharis*, subser. *Palustres*. III. Observations on European taxa. Opera Bot. 9:2: 1–86.

———. 1966. Morphologic variation and taxonomy in European *Eleocharis*, subser. *Palustres*. Opera Bot. 10: 2: 1–187.

———. 1967. *Eleocharis*, subser. *Eleocharis* in North America. Taxonomical comments and chromosome numbers. Bot. Not. 121: 355–368.

——— & R. Dahlgren. 1967. Drawings of Scandinavian plants 9 to 16. Bot. Not. 121: 1–10.

Svenson, H. K. 1929. Monographic studies in the genus *Eleocharis*. Rhodora 31: 122–135; 167–192.

———. 1932. Monographic studies in the genus *Eleocharis* II. Rhodora 34: 193–203, 215–227.

———. 1934. Monographic studies in the genus *Eleocharis* III. Rhodora 35: 377–389.

———. 1957. *Eleocharis*. Pp. 509–540 *in* North Ameri-

can Flora vol. 18, part 9. New York Botanical Garden, Bronx.

———. 1966. Letter to H. H. Iltis, University of Wisconsin-Madison (see Appendix below).

Swink, F. & G. Wilhelm. 1994. Plants of the Chicago Region, ed. 3. Morton Arboretum, Lisle, Illinois.

Taylor, T. M. C. 1983. The Sedge Family. Handbook No. 43, British Columbia Provincial Museum. Victoria.

Trustees of the Royal Botanic Gardens, Kew. 1997. Index Kewensis CD-ROM, ver. 2.0. Oxford Univ. Press, Oxford.

USDA, NRCS. 2001. The PLANTS Database, ver. 31. <http:\\plants.usda.gov> National Plant Data Center, Baton Rouge, Louisiana.

Voss, E. G. 1972. Michigan Flora. I. Gymnosperms and Monocots. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

Walters, S. M. 1980. *Eleocharis*. Pp 281–284 *in* T. G. Tutin et al. (editors), Flora Europaea. Cambridge Univ. Press, Cambridge.

Appendix. Extract from letter from H. K. Svenson to H. H. Iltis (5 May 1966): "I am returning the specimens of *Eleocharis*, chiefly from Wisconsin. As I surmised, this fine collection of material might well have solved the troublous problem of the relationships of *Eleocharis compressa* and *E. elliptica*, and it has done so to my satisfaction. My error lay in placing too much emphasis on the flattened stem structure of the Great Lakes material. What I called *E. compressa* var. *atrata* I now feel confidently should be placed under *E. elliptica*. Whether these culms are truly ancipital in the sense of *E. compressa* I now have my doubts. . . .

The achenes, including tubercle, were correctly portrayed by me in Rhodora 34: Pl. 219, fig. 61 and 63. 1932. I have collected good material of *E. acutisquamata* in Texas, and it should be included under *E. compressa*. In Rhodora 34: plate 221, the correct achene is shown as a photograph. I am not certain about fig. 5, of the same plantplate, and suspect some error may have crept in. The achene of *E. compressa* is very fine-meshed as compared with *E. elliptica*; the color is olive [i.e. yellow-brown] as contrasted with the deep yellow of *E. elliptica*; the achenes are a little narrower in *E. compressa*, and generally lack the corrugation of surface seen in *E. elliptica*. The scales *of E. compressa* are also firmer, with a consistency much as in eastern *E. smallii*. . . ."

Revision of the Cretaceous Fossil Genus *Palaeoaster* (Papaveraceae) and Clarification of Pertinent Species of *Eriocaulon*, *Palaeoaster*, and *Sterculiocarpus*

Una R. Smith

Department of Ecology & Evolutionary Biology, Yale University, New Haven, Connecticut 06520-8106, U.S.A. Current address: Los Alamos National Laboratory, Mail stop K710, Los Alamos, New Mexico 87545, U.S.A.

ABSTRACT. The fossil organ genus *Palaeoaster* (Papaveraceae), from the Cretaceous Western Interior of North America, is revised to contain a single species, the new combination *P. porosa*. The type status is clarified and lectotypes are selected for the basionym *Eriocaulon? porosum* (Eriocaulaceae) and synonyms *P. inquirenda*, *P? similis*, and *Sterculiocarpus coloradensis* (Sterculiaceae). This revision reflects an informal circumscription of *Palaeoaster* in use since the late 1930s, and is the first of several papers on this genus.

Key words: Cretaceous, *Eriocaulon*, fossil, North America, *Palaeoaster*, Papaveraceae, *Sterculiocarpus*.

Since the 1870s, *Palaeoaster* has been a familiar and sometimes controversial element in the fossil record of the latest Cretaceous Western Interior of North America, where this fossil occurs from 74.5 MY (million years) in the Fruitland Formation in New Mexico to 64.5 MY in the Hell Creek Formation in North Dakota (Smith, 2000). Although this fossil was important to historical debates about the stratigraphic position of the Cretaceous–Tertiary boundary in the Western Interior, its morphological identity and taxonomic affinity remained unknown for over a century; *Palaeoaster* has often been described as "problematic" (e.g., Brown, 1962).

Palaeoaster, originally *incertae sedis*, is a large capsular fruit related to the basal eudicot family Papaveraceae (Smith, 2000, in press; Figs. 1, 2). The fruit dehisces, forming long valves. All specimens of *Palaeoaster* described prior to 1932 are dehisced fruits, missing some of their valves, that were misinterpreted as clusters of leaves. Apparently, the name *Palaeoaster* reflects the superficial resemblance between these putative leaves and the involucral capitulum of *Aster* and other genera of Asteraceae.

Knowlton (1917) based the genus *Palaeoaster* on his new species, *P. inquirenda*, not on the earlier *Eriocaulon? porosum* (Lesquereux, 1874). However, as suggested by a number of paleobotanists and as confirmed by my examination of original material, the relevant specimens all belong to a single species. Lesquereux's name is older, but cannot be retained because it applies to an unrelated extant genus, so a new combination in *Palaeoaster* is required. Per the ICBN (Greuter et al., 2000) Article 7.4, the type of the new combination *P. porosa* is the lectotype of the basionym *Eriocaulon? porosum*; however, per Article 7.2, the type of the genus *Palaeoaster* remains the lectotype of *P. inquirenda*.

Palaeoaster F. H. Knowlton, Fossil Floras of the Vermejo and Raton Formations of Colorado and New Mexico: 278. 1917. TYPE: *Palaeoaster inquirenda* F. H. Knowlton.

1. Palaeoaster porosa (Lesquereux) U. R. Smith, comb. nov. Basionym: *Eriocaulon? porosum* Lesquereux, [7th] Annual Report of the United States Geological and Geographical Survey of the Territories: 396. 1874. TYPE: U.S.A. Colorado: "Sand Creek," 1873, *W. H. Holmes* (lectotype, selected here, USNM 137).

Palaeoaster inquirenda F. H. Knowlton, Fossil Floras of the Vermejo and Raton Formations of Colorado and New Mexico: 278. 1917. Syn. nov. TYPE: U.S.A. Colorado: "Alkali Gap," 1910, *W. T. Lee and others* (lectotype, selected here, USNM 34527).

Lectoparatypes, selected here, USNM 458511, 458512, 458513, 458514.

Palaeoaster? similis F. H. Knowlton, Laramie fl. Denver: 168. 1922. Syn. nov. TYPE: U.S.A. Colorado: "Murphy coal bank" on Ralston Creek, 1890, *A. Lakes* (lectotype, selected here, USNM 36804).

Lectoparatype, selected here, USNM 36803.

Sterculiocarpus coloradensis E. W. Berry, J. Wash. Acad. Sci. 22: 119. 1932. Syn. nov. TYPE: U.S.A. Colorado: Ramah, *C. Shelton s.n.* (holotype, as of 1995 property of V. Shelton).

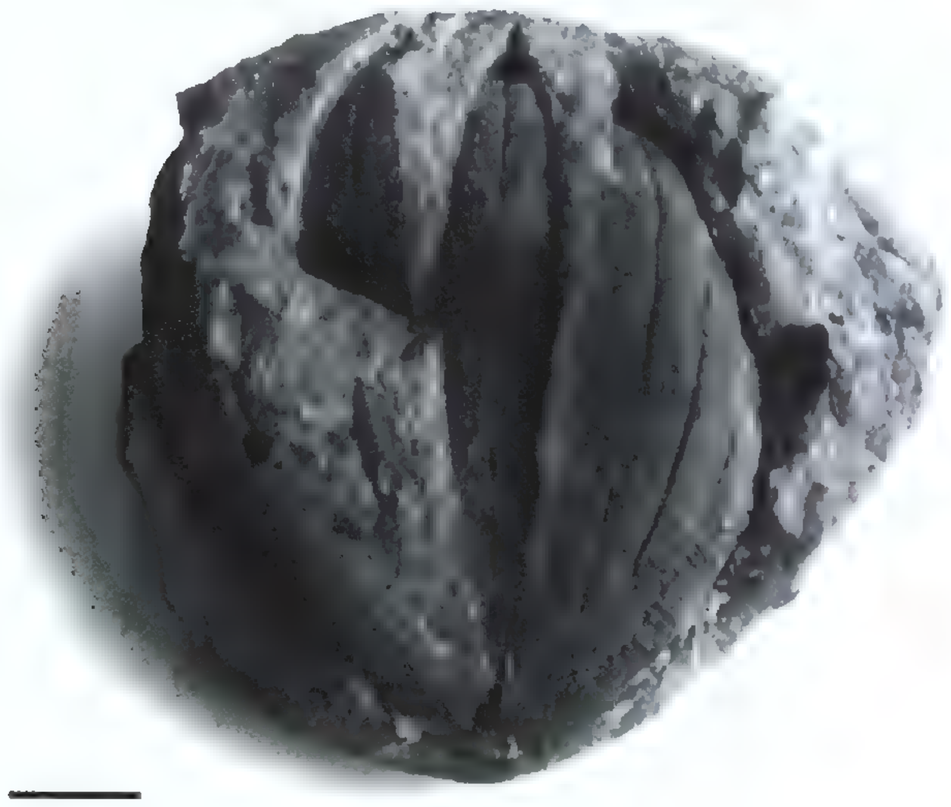


Figure 1. Specimen 4380, a dehisced fruit of *Palaeoaster* from the excavation site of the spectacular *Tyrannosaurus rex* specimen BHI 3033 ("STAN"); the inner faces of the valves are preserved as impressions in sandstone. Collected by Neal L. Larson and others. Scale bar = 1 cm.

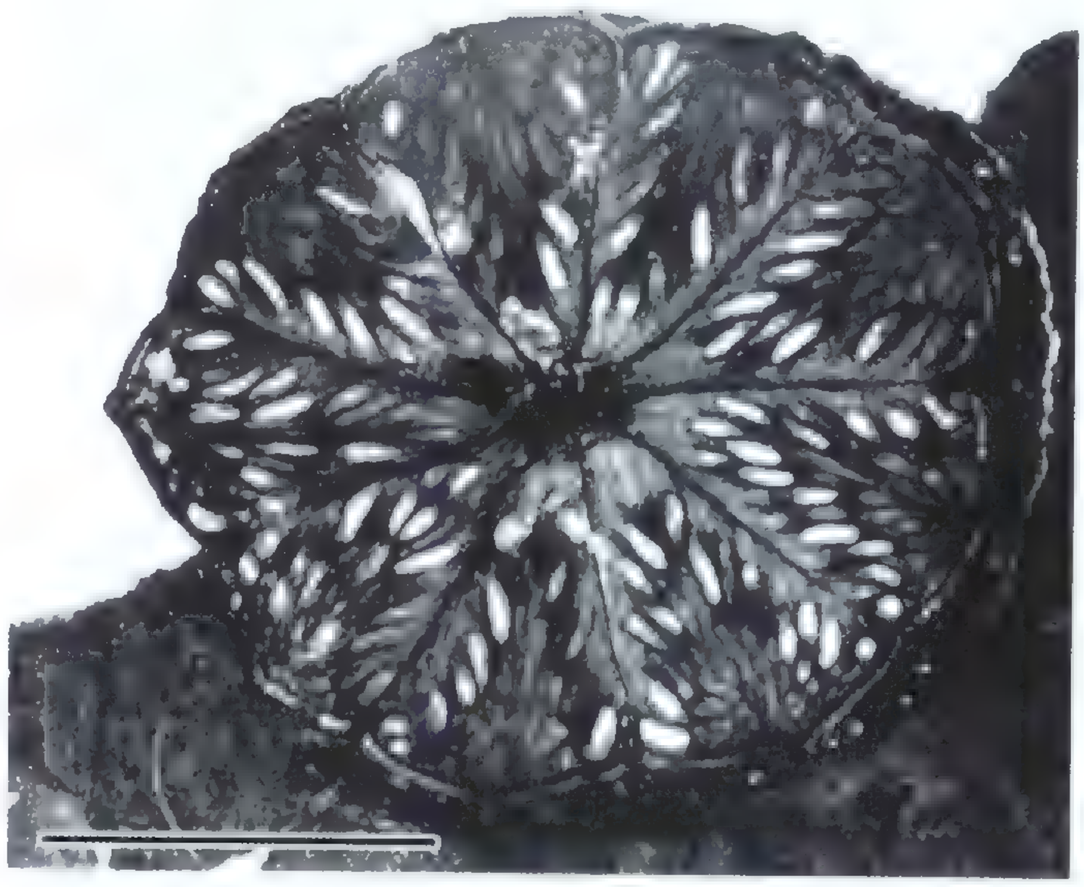


Figure 2. Specimen BHI 4001, cross section of a permineralized fruit of *Palaeoaster.* Collected by the Black Hills Institute. Scale bar = 1 cm.

The original description of *Eriocaulon? porosum* (Lesquereux, 1874: 396) does not show or designate the single specimen on which it is based; figures added to a reprint of that description (Lesquereux, 1878: 106, pl. 16, figs. 2–2a) show *Palaeoaster* specimen USNM 137. Additional specimens of *Palaeoaster* were identified as *E? porosum* by Knowlton (Gale, 1910; Lee, 1912; Knowlton, 1930). *Eriocaulon* is an extant genus of the monocot family Eriocaulaceae. Despite warnings that the taxonomic assignment of *E? porosum* to *Eriocaulon* was based on superficial evidence (Lesquereux, 1878; Knowlton, 1930: 132–133), numerous authors accepted this species as fossil evidence of Eriocaulaceae (Coulter & Chamberlain, 1903; Marty, 1907; Horwood, 1912; Chesters et al., 1967; Němejc, 1975). Daghlian (1981) excluded *E? porosum* from Eriocaulaceae, leaving this species *incertae sedis.*

In his original description of *Palaeoaster inquirenda,* Knowlton (1917: 278, pl. 49, figs. 5, 6) stated that "the type specimens . . . are contained in a large collection from Alkali Gap." The collection from this locality at USNM contains the figured specimen, USNM 34527, and four other specimens of *Palaeoaster.* Knowlton (1917) described *P. inquirenda* ambiguously as "leaves" or a "capsule" (his quotes), based on specimens that he removed from *Eriocaulon? porosum.* However, Knowlton's concept of these two species is badly flawed: he assigned specimens found above the Cretaceous–Tertiary boundary (as recognized then) to *E? porosum,* and specimens found below the boundary to *P. inquirenda,* without noting any clear morphological differences (there are none). Knowlton then used these two species to locate the Cretaceous–Tertiary boundary (e.g., Knowlton, 1930), thereby introducing a circularity problem into the stratigraphy of the Western Interior. Brown (1943: 72) considered *P. inquirenda* to be a synonym of *E? porosum,* but did not make the required new combination.

Knowlton (1919: 427) created *Palaeoaster? similis* as a *nomen nudum.* In his later description, Knowlton (1922: 168, pl. 24, figs. 10–11) figured two specimens of *Palaeoaster* but did not select one of them as the holotype; USNM 36804 is the more complete specimen. Knowlton (1922) remarked that individual "leaves" (his quotes) of *P? similis* are "practically indistinguishable" from those of *P. inquirenda*; it appears that he distinguished *P? similis* from *P. inquirenda* by the (supposed) occurrence of *P? similis* above the Cretaceous–Tertiary boundary. Dorf (1938, 1942) made *P? similis* a synonym of *P. inquirenda.*

Berry (1932) correctly identified as a fruit the first undehisced specimen of this fossil to be described, which he named *Sterculiocarpus coloradensis. Sterculiocarpus* is a form genus of fossil fruits with a superficial resemblance to certain fruits of the extant eudicot family Sterculiaceae. After dehisced and undehisced specimens of *Palaeoaster* were found together at several localities, Dorf (1938, 1942) suggested and Brown (1943) agreed that *S. coloradensis* is a synonym of *P. inquirenda.* Neither author made a formal synonymy.

The paleobotanical literature includes two significant errors of identification relevant to *Palaeoaster.* Marty (1907: 12–14, pl. 1, fig. 3) figured a single specimen from the Tertiary of Europe that he confidently assigned to *E? porosum.* The specimen, IRSNB 68664, does not belong to this spe-

cies. Lesquereux (1873: 400) briefly described a single specimen that he tentatively assigned to *Eucalyptus haeringiana?* Ettingshausen. *Eucalyptus haeringiana* is a fossil species from the Tertiary of Europe, based on leaves and associated fruits that resemble the extant genus *Eucalyptus* of the primarily Australian eudicot family Myrtaceae. The figure with Lesquereux's reprinted description (Lesquereux, 1878: 296, pl. 59, fig. 10) shows *Palaeoaster* specimen USNM 488. This specimen, cited by some of Lesquereux's contemporaries as *Eucalyptus haeringiana?* Lesquereux (i.e., not Ettingshausen), was excluded from *Eucalyptus* and left *incertae sedis* by Maiden (1924: 222); Knowlton (1930: 133) considered this specimen to be "probably . . . congeneric" with Lesquereux's (1874) *Eriocaulon? porosum.*

Acknowledgments. This paper is based on a doctoral dissertation funded by Yale University Graduate School and Yale Institute for Biospheric Studies. Access to cited specimens was provided by: Division of Paleobotany, U.S. National Museum of Natural History, Washington DC (USNM); Black Hills Institute of Geological Research, Hill City, South Dakota (BHI); Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (IRSNB); and Vivian Shelton, Ramah, Colorado. Steven R. Manchester (with Judith E. Skog and Robert A. Fensome) and one anonymous reviewer made helpful comments on the manuscript.

Literature Cited

Berry, E. W. 1932. A sterculiaceous fruit from the lower Eocene (?) of Colorado. J. Wash. Acad. Sci. 22: 119–121.

Brown, R. W. 1943. Cretaceous–Tertiary boundary in the Denver Basin, Colorado. Bull. Geol. Soc. Amer. 54: 65–86, 2 plates.

———. 1962. Paleocene flora of the Rocky Mountains and Great Plains. Profess. Pap. U.S. Geol. Surv. 375.

Chesters, K. I. M., F. R. Gnauck & N. F. Hughes. 1967. Angiospermae. Pp. 269–288 *in* W. B. Harland et al. (editors), The Fossil Record. Geological Society of London.

Coulter, J. M. & C. J. Chamberlain. 1903. Morphology of angiosperms. D. Appleton, New York.

Daghlian, C. P. 1981. A review of the fossil record of monocotyledons. Bot. Rev. 47: 517–555.

Dorf, E. 1938. Upper Cretaceous floras of the Rocky Mountain Region. I. Stratigraphy and palaeontology of the Fox Hills and lower Medicine Bow formations of southern Wyoming and northwestern Colorado. Publ. Carnegie Inst. Wash. 508: 1–78.

———. 1942. Upper Cretaceous floras of the Rocky Mountain region. II. Flora of the Lance Formation at its type locality, Niobrara County, Wyoming. Publ. Carnegie Inst. Wash. 508: 79–159.

Gale, H. S. 1910. Coalfields of northwestern Colorado and northeastern Utah. Bull. U.S. Geol. Surv. 415.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (St Louis Code). Regnum Veg. 138.

Horwood, A. R. 1912. The past history of monocotyledons, with remarks on their origins. Scott. Bot. Rev. 1: 164–180, 216–234.

Knowlton, F. H. 1917. Fossil floras of the Vermejo and Raton formations of Colorado and New Mexico. Profess. Pap. U.S. Geol. Surv. 101: 223–435.

———. 1919. A catalogue of the Mesozoic and Cenozoic plants of North America. Bull. U.S. Geol. Surv. 696.

———. 1922. The Laramie flora of the Denver Basin, with a review of the Laramie problem. Profess. Pap. U.S. Geol. Surv. 130.

———. 1930. The flora of the Denver and associated formations of Colorado (posthumous, edited by E. W. Berry). Profess. Pap. U.S. Geol. Surv. 155.

Lee, W. T. 1912. Coal fields of Grand Mesa and the west Elk Mountains, Colorado. Bull. U.S. Geol. Surv. 510.

Lesquereux, L. 1873. Lignitic formation and fossil flora. Pp. 317–427 *in* F. V. Hayden (editor), Sixth Annual Report of the United States Geological Survey of the Territories; embracing portions of Montana, Idaho, Wyoming, and Utah, being a report of progress of the explorations for the year 1872. Government Printing Office, Washington, D.C.

———. 1874. The lignitic formation and its fossil flora. Pp. 365–425 *in* F. V. Hayden (editor), [Seventh] Annual Report of the United States Geological and Geographical Survey of the Territories, Embracing Colorado, Being a Report of Progress of the Exploration for the year 1873. Government Printing Office, Washington, D.C.

———. 1878. Contributions to the fossil flora of the Western Territories. Part 2. The Tertiary flora. Report of the United States Geological Survey of the Territories, vol. 7. Government Printing Office, Washington, D.C.

Maiden, J. H. 1924. Fossil plants attributed to *Eucalyptus.* Pp. 168–190, 219–244 *in* J. H. Maiden, A Critical Revision of the Genus *Eucalyptus,* Vol. 6. Alfred James Kent, Government Printer, Sydney, New South Wales.

Marty, P. 1907. Études sur les végétaux fossiles du Trieu de Leval (Hainaut). Mém. Mus. Roy. Hist. Nat. Belgique 5: 1–52, 9 plates.

Němejc, F. 1975. Paleobotanika, vol. 4. Nakladatelství Československé Akademie Věd, Praha.

Smith, U. R. 2000. *Palaeoaster* (Papaveraceae), the Cretaceous Poppy. Ph.D. Dissertation, Yale University, New Haven, Connecticut.

———. In press. Permineralized fossil fruits of *Palaeoaster,* a Late Cretaceous genus of Papaveraceae. Int. J. Plant Sci.

Novelties in *Rhynchospora* (Cyperaceae) from the Guianas

Mark T. Strong
Department of Systematic Biology, MRC/166, Smithsonian Institution,
10th & Constitution Avenue, Washington, D.C. 20560-0166, U.S.A.

Abstract. Five new species are described (*R. angustipaniculata, R. ayangannensis, R. bakhuisensis, R. donselaarii,* and *R. rupicola*) and a new name proposed (*R. pubisquama*) in *Rhynchospora* Vahl nom. cons. from northeastern South America (Guianas). Illustrations are provided for the new species, their classification is determined, and a discussion of related species is given for each.

Key words: Cyperaceae, Guianas, *Rhynchospora,* South America.

Rhynchospora Vahl nom. cons. is a genus of approximately 250 species worldwide. It is most diverse in the Western Hemisphere, particularly warm-temperate North America and the Neotropics. Eighty taxa (including the new taxa described here) are currently known from the Guianas (Guyana, Surinam, and French Guiana).

Species of *Rhynchospora* are very diverse vegetatively and can range from diminutive annuals less than 10 cm tall to large rhizomatous perennials up to 3 m tall. The leaves are primarily basal, 2 to several cauline, linear to filiform, dorsiventrally compressed, and often have scabrous margins. The inflorescence structure is rather diverse and can range from a single solitary spikelet or capitate head of spikelets at the summit of the culm to large decompound panicles of many spikelets, often composed of a terminal and a series of 1 to several lateral, remote or contiguous, simple to compound, corymbiform or cymose partial panicles from the upper sheathing bracts. The floral morphology is generally uniform and can be characterized as follows: spikelets have spirally arranged scales, with (1)2 to many basal scales empty (sterile); the fertile scales are borne above these and each subtends a perfect flower, or often the terminal 1 or 2 scales are staminate only with abortive pistil; each flower has (1)2 or 3 stamens; the style is 2-branched or entire; and achenes are biconvex or lenticular, are often transversely rugose or rugulose, and bear at their apex the persistent triangular, triangular-lanceolate, or discoid style base.

In preparing *Rhynchospora* for the *Flora of the Guianas,* I noted five new species, which are here validated. In addition, a nomenclatural change is necessary for elevating a variety of *R. cephalotes* (L.) Vahl to the species rank. The species are given in alphabetic order.

Rhynchospora angustipaniculata M. T. Strong, sp. nov. TYPE: Guyana. Potaro-Siparuni Region: summit of Mt. Kopinang, 05°00′N, 59°55′W, 1700–1800 m, 8 Apr. 1988, *W. Hahn 4374* with *E. Judziewicz & D. Gopaul* (holotype, BRG; isotypes, MO, NY, US 3385739). Figure 1.

Haec species inter congeneros sectionis *Paniculatarum* Boeckeler *R. longiflorae* C. Presl affinis, sed ab ea laminae foliaris costa abaxialiter setosa atque achenio longiore in rostrum longius bilobum basi non articulatum desinente et setis longioribus subtento differt.

Caespitose perennial; rhizome short, thick; sheathing base of culm 4–6 mm wide; roots stiff, branched. Culms slender, ascending, 6–8 dm tall, 0.7–2 mm wide, trigonous proximally with concave sides, compressed-trigonous distally, finely ribbed, smooth, green, glabrous except for appressed to ascending setose trichomes just below nodes and sometimes scattered along ribs, canaliculate along one side distally, the edges of the channel antrorsely scabrous, the bottom of the channel with setose trichomes borne singly or in tufts. Leaves ascending, primarily basal, 6 to 10 (including the sheathing bracts subtending partial panicles), elongate; sheaths finely and coarsely veined, essentially glabrous near base, with setose trichomes distally, the inner band membranous, densely setose at apex, the orifice with a glabrous, reddish brown band at the concave to truncate apex, splitting with age, the adaxial surface honey-colored, the abaxial surface light brown; ligule a narrow, inconspicuous band of appressed trichomes; blades to 6 dm long, 2–5 mm wide, narrowly linear, flattened to plicate or subinvolute, long-acuminate to apex, finely veined, gray-green, becoming light brown with age, scabrous on margins and midcosta both adaxially and abaxially, the adaxial surface smooth and glabrous proximally, scabrous distally, shiny, with an inconspicuous, antrorsely scabrous midcosta, the abaxial surface smooth, honey-colored at base, glabrous ex-

Figure 1. *Rhynchospora angustipaniculata* M. T. Strong. —A. Habit. —B. Detail of inflorescence panicle branch with spikelets. —C. Spikelet. —D. Spikelet scale. —E. Achene. (Drawn from the isotype, *Hahn 4374*, US.)

cept for the prominent midcosta, which has dense, setose trichomes borne singly or in tufts along each side at base. Inflorescence of 2 to 4 narrow panicles from the upper sheathing bracts, 2–6 × 1–2.5 cm; sheathing bracts leaf-like, but reduced; peduncles compressed-trigonous or subflattened, antrorsely scabrous on angles, elongate, flexuous, 0.4–0.5 mm wide; panicle branches short, trigonous, scabrous-hispid on angles and in lines on side facing spikelet, the branches and spikelet pedicels each subtended by a tubular prophyll and linear bract at base, the lower bract ovate-acuminate and long-awned, the upper prophyll smaller, ovate, truncate at apex, unawned. Spikelets ovoid-lanceoloid, 2 to 18 per panicle, solitary and short-pedicellate, mature fruiting spikelets (8–)9–14(–15) × 1.3–1.8 mm, 1–1.3 mm wide at anthesis; scales 8 to 12 per spikelet, thinly herbaceous, essentially glabrous, light brown with brown lineations, midcosta indistinct proximally, prolonged at apex as a short, antrorsely scabrous awn, the margins narrowly scarious; fertile scales 4 to 7, lanceolate-ovate, 4.5–9 × 2–3 mm, scabrous along the midcosta distally; sterile scales 4 to 5 at spikelet base, ovate, subdistichous, smaller than the fertile, 1.5–3.5 mm long (excluding awn), 1–2 mm wide. Flowers perfect, 2 or 3(to 4) maturing achenes, the distal flowers of a spikelet staminate with abortive pistil; stamens 3, the anthers linear, 2–3 mm long, basifixed, thecae parallel, longitudinally dehiscent, apiculate at apex; styles simple, unbranched, glabrous, the tip expanded. Achene biconvex, widely elliptic to elliptic-obovoid, 1.9–2.2 mm long (excluding style base), (1.3–)1.5–1.8 mm wide, minutely and somewhat obscurely cancellate, appearing smooth at low magnification, yellowish brown; style base triangular-lanceolate, 2.5–3.5 mm long, 1–1.2 mm wide at base, 2-lobed and subconfluent at base with the achene apex, the junction of achene apex and base of the style base bordered only by a low marginal ridge, light brown to light grayish brown, thin, somewhat spongy; bristles 6, antrorsely barbed, exceeding the achene, shorter than to rarely reaching the tip of the style base.

Habitat and distribution. At present, known only from rock outcrops on the summits of Mts. Ayanganna and Kopinang, Pakaraima Mountains, Guyana.

With its culms that are canaliculate along one side (at least distally), inflorescence of partial panicles from the upper sheathing bracts, unbranched style, cellular-cancellate achene surface, and elongate perianth bristles, *Rhynchospora angustipaniculata* is best placed in *R.* sect. *Paniculatae* Böckeler as circumscribed by Kükenthal (1949). However, the 6-sided achene epidermal cells of *R. angustipaniculata,* even though they are characteristic of species in that section, differ in being somewhat isodiametric, while in *R.* sect. *Paniculatae* and the closely related *R.* sect. *Racemosae* C. B. Clarke, they are typically elongated (appearing rectangular at low magnification) and oriented horizontally to the main axis (at least medially). In addition, the style base of *R. angustipaniculata* is subconfluent with the achene apex and separated only from it by a low, marginal ridge, while species of *R.* sect. *Paniculatae* and *R.* sect. *Racemosae* generally have a style base that is articulate with the achene apex. In habit, *R. angustipaniculata* is very similar to the West Indian species *R. domingensis* Urban. However, it seems to have its closest affinities to another West Indian species, *R. longiflora* Presl. From *R. longiflora, R. angustipaniculata* differs in having leaf blades with setiferous midcostas abaxially (vs. scabrous), narrower inflorescence panicles, slightly longer achenes (1.9–2.2 vs. 1.7–2 mm long), a longer style base (2.5–3.5 vs. 1.5–2.5 mm long) that is 2-lobed at its base and subconfluent with the achene apex (that of *R. longiflora* is unlobed at its base and articulated with achene apex); and longer perianth bristles.

The epithet alludes to the narrow inflorescence panicles of the species.

Paratypes. GUYANA. **Cuyuni–Mazaruni Region:** Pakaraima Mountains, 2 km transect along summit ridge of Mt. Ayanganna, low sclerophyllous community, organic soils on sandstone, in cliff crevices, 05°23′N, 59°59′W, 1800–2000 m, 3 Nov. 1992, *B. Hoffman 3187* with *T. Henkel* (BRG, MO, NY, US).

Rhynchospora ayangannensis M. T. Strong, sp. nov. TYPE: Guyana. Cuyuni–Mazaruni Region: Pakaraima Mountains, NE plateau of Mt. Ayanganna, open scrub, moist slopes and small plateaus, occasional exposed sandstone, 05°23′N, 59°58′W, 1500–1650 m, 1 Nov. 1992, *T. Henkel 88* with *B. Hoffman* (holotype, BRG; isotypes, K, MO, NY, US 3385737). Figure 2.

Haec species a congeneris sectionis *Pseudoaurearum* C. B. Clarke achenio obpyriformi ad subturbinato stipitato in rostrum triangulari-lanceolatum ad lanceolatum desinente distinguitur.

Coarse rhizomatous perennial; rhizome short, bulbous-thickened, the culms borne singly or sometimes 2 together from the rhizome; sheathing base of culm 2–3 cm wide; roots coarse, stiff. Culms stout, erect to ascending, 1–1.7 m tall, 3–6 mm wide near base, narrowing to 1 mm distally, trigon-

Figure 2. *Rhynchospora ayangannensis* M. T. Strong. —A. Habit. —B. Detail of inflorescence panicle branch with spikelets. —C. Spikelet. —D. Spikelet scale. —E. Achene. (Drawn from the isotype, *Henkel 88*, US.)

ous with blunt angles, the sides plane or concave proximally, finely ribbed, smooth, glabrous, green to brownish, shallowly canaliculate along one side distally, the edges of the channel antrorsely scabrous. Leaves ascending, basal and cauline, numerous, elongate; sheaths finely veined, glabrous, greenish brown to brown, the basal sheaths reddish brown adaxially near base, with a membranous, reddish brown inner band and deeply U-shaped orifice, splitting with age, the cauline sheaths with a herbaceous inner band and U-shaped, scarious-tipped orifice; ligule absent; blades of basal leaves narrowly linear, flattened to subplicate, to 1.5 m long, 1–1.8 cm wide, finely veined, greenish brown to brown, somewhat glossy, antrorsely scabrous on margins, very long-acuminate to a trigonous-subulate apex, the adaxial surface with convex epidermal cells that give the surface a minutely bullate texture, glabrous proximally, scabrous distally, the abaxial surface minutely papillose, glabrous, the midcosta antrorsely scabrous distally, smooth below; blades of cauline leaves like the basal ones, but becoming increasingly shorter and narrower toward apex of culm. Inflorescence of 4 or 5, remote, pyramidal partial panicles from the upper sheathing bracts, panicles (3.5–)4–7(–7.6) × 4–8 cm, the lower long-pedunculate, with 20 to 70 spikelets, the terminal panicle with 50 to 150 spikelets; sheathing bracts leaf-like, gradually reduced distally; peduncles slender, 0.9–1 mm wide, elongate, flexuous, subflattened to compressed-trigonous or plano-convex in cross section, finely ribbed, smooth to remotely antrorsely scabrous on angles proximally, scabrous distally on two angles, the sides glabrous; panicle branches plano-convex, trigonous, or 4-angled toward apex of main axes, the margins narrowly winged, setose-scabrous on the wing angles, each subtended by a tubular prophyll and linear bract at base of both branches and spikelet pedicels, the lower bract ovate-lanceolate, long-awned, ciliate-scabrous on margins and nerves, the upper prophyll smaller, ovate, truncate at apex, unawned, essentially glabrous. Spikelets ellipsoid, mature fruiting spikelets 5–6 × 1.8–2.5 mm, borne singly on branches, pedicelled, the terminal spikelet of a branch short-pedicelled or subsessile, the pedicels terete to subflattened, essentially glabrous; scales 13 to 15 per spikelet, thin, somewhat translucent, light greenish brown to stramineous, glabrous, with a single, inconspicuous, greenish midcosta, the apex acute to acuminate, short-mucronate; fertile scales 9 or 10, ovate-elliptic, (3–) 3.2–4 × (1.1–)1.5–2.2(–2.4) mm; sterile scales 4 or 5 at spikelet base, ovate to ovate-elliptic, smaller than the fertile, (1.4–)1.5–2.9(–3) × 1–1.5(–1.6) mm. Flowers perfect, all maturing achenes; stamens 3, the anthers linear, 0.8–1.2 mm long, basifixed, apiculate at apex, thecae parallel, longitudinally dehiscent; styles 2-branched, glabrous, black, the branches about as long as the unbranched portion. Achene biconvex, with convex or bulging faces, obpyriform to subturbinate, 2–2.2 mm long (including stipitate base), (0.9–)1–1.1 mm wide, the stipe (0.5–)0.6–0.8(–0.9) mm long, shallowly cellular-reticulate to essentially smooth, orange-brown to dark brown, glossy; style base triangular-lanceolate to lanceolate, (1.1–)1.2–1.5(–1.6) mm long, 0.4–0.8 mm wide at base, thin, flattened, narrower than achene, sulcate above the ridged, obtuse to truncate apex of achene, inconspicuously cellular-reticulate and wrinkled, light brown to grayish brown, sometimes whitened at base; bristles 6, antrorsely barbed, 4 to 6 greatly overtopping the achene, equaling to shortly exceeding the style base, 1 to 2 sometimes shorter than the achene or rudimentary.

Habitat and distribution. Known only from Mt. Ayanganna, Pakaraima Mountains, Guyana, on moist slopes and small plateaus in low forest or open scrub at 1400–1650 m.

With its stout culms and well-developed leaves with blades 10–18 mm wide; inflorescence of 4 or 5, remote, pyramidal partial panicles from the upper sheathing bracts; ovoid-ellipsoid spikelets; pale brown spikelet scales with reddish lineations; 2-branched style; glossy, orange-brown to brown, shallowly cellular-reticulate to essentially smooth achenes; and 5 or 6 well-developed antrorsely barbed perianth bristles, *Rhynchospora ayangannensis* seems to be best placed in *R.* sect. *Pseudoaureae* C. B. Clarke. However, the obpyriform to subturbinate achene with stipitate base and triangular-lanceolate to lanceolate style base are uncharacteristic of other South American species assigned to that section. Kükenthal (1949) included three species in *R.* sect. *Pseudoaureae, R. metralis* C. B. Clarke, *R. paraensis* Shrader ex Kunth, and *R. sclerioides* Hooker & Arnott. Of these, the first two are South American species, while *R. sclerioides* is native to Polynesia. *Rhynchospora ayangannensis* is most closely related to *R. metralis* and *R. paraensis*, which differ from it in having achenes that are obovate, estipitate (or at most shortly attenuate at base), and have a style base that is triangular. However, the achene of *R. ayangannensis* does show affinities to these two species, including the 6-sided, isodiametric cells of the epidermis; rimmed apex; and elongate perianth bristles that are persistent at its base. The achenes of *R. sclerioides* are more characteristic of species in *R.* sect.

Paniculatae both in orientation of the epidermal cells (see discussion under *R. angustipaniculata*) and the lanceolate-attenuate style base that is articulate with the achene apex (not conic-subulate as described by Kükenthal) and it is perhaps better placed there. However, *R. sclerioides* has a deeply 2-branched style, which allies it to *R.* subg. *Diplostyleae* Bentham & Hooker. Species of *R.* sect. *Paniculatae* typically have an unbranched or slightly bilobed style and are included under *R.* subg. *Haplostyleae* (Nees) Bentham & Hooker.

Paratype. GUYANA. Upper Mazaruni River basin, Mt. Ayanganna, frequent in Thompson Camp, 1418 m, 12 Aug. 1960, *S. Tillett & C. Tillett 45121* (NY).

Rhynchospora bakhuisensis M. T. Strong, sp. nov. TYPE: Surinam. In montibus Bakhuis inter flum, Kabalebo et Coppename Sinistrum, Bakhuis Mountains, top near camp 3, 600–700 m, 22 Feb. 1965, *P. Florschütz & P. Maas 2954* (holotype, U 029604). Figure 3.

Haec species inter congeneros sectionis *Pseudoaurearum* C. B. Clarke *R. paraensi* Schrader ex Kunth affinis, sed ab ea culmis et foliis glabris, lamina foliari marginibus non nisi obtuse scabris atque achenio 1.0–1.3 mm longo 0.9–1.1 mm lato setis 1.5–2.0-plo longioribus subtento et in rostrum complanatum non nisi leviter incrassatum marginibus basi laevibus, desinente differt.

Robust perennial with narrow, vertical, woody caudex bearing fibrous remnants of old leaf bases, the culms borne singly from the rhizome; roots coarse; sheathing base of culm 1–1.5 cm wide. Culm ascending, 1–1.5 m tall, 3–6 mm wide proximally, triquetrous, firm, finely ribbed and channeled, glabrous, dark green, shallowly canaliculate along one side distally. Leaves ascending, numerous, primarily basal, 2 or 3 cauline below the inflorescence, elongate; sheaths short, finely veined, septate-nodulose, glabrous, brown, inner band firm, the orifice deeply U-shaped with a ciliate margin; ligule absent; blades of basal leaves narrowly linear, flattened to subfolded or V-shaped toward base, subplicate distally, up to 1.5 m long, 1.2–2.5 cm wide, finely veined, septate-nodulose, glabrous, smooth, deep green, minutely punctate between veins abaxially, bluntly scabrous on margins and abaxial midvein, long-acuminate to apex; blades of cauline leaves like the basal ones but becoming increasingly shorter and narrower toward apex of culm. Inflorescence ca. 50 cm long, of 5 remote, partial panicles (including the terminal one) from the upper sheathing bracts, the partial panicles somewhat open, globose to obtusely trigonous, 5–6 cm diam., with 240 to 320 spikelets each; sheathing bracts leaf-like, gradually reduced distally; peduncles short, that of the lowest panicle to 5 cm long, 1–1.2 mm wide, slender, flattened, finely ribbed, short pubescent; panicle branches trigonous to flattened-trigonous or plano-convex, pubescent, horizontally divergent to reflexed or only the uppermost ascending, each subtended by a tubular prophyll and linear bract at base, the bract ovate-lanceolate, long-awned, ciliate-scabrous on margins and nerves, the prophyll smaller, ovate, truncate at apex, unawned, pubescent; pedicels of spikelets, when present, short, flattened-trigonous to flattened, short-pubescent, the spikelets congested at tips of lateral branches, borne singly or more commonly sessile and in fascicles of 2 or 3 at branch tips. Spikelets narrowly ovoid-ellipsoid to oblong-ovoid, 3.6–5 × 1–1.2 mm, the scales spreading at maturity, the spikelets then to 2 mm wide, greatly elongating when insect galls present; scales 11 to 13, thinly herbaceous, light brown to reddish brown, glabrous, with narrow scarious entire margins, lateral nerves indistinct, the narrow pale green midcosta prolonged at apex as a 0.3–0.5 mm antrorsely scabrous awn; fertile scales 3 to 5, oblong-ovate, 2.4–3 × 1–1.3 mm, sterile scales 7 to 10, ovate to oblong-ovate, decreasing in length to base, 0.5–2.3 mm long. Flowers perfect; stamens 3, the anthers linear, 1.5–2 mm long, apiculate at apex, basifixed, thecae parallel, longitudinally dehiscent; style 2-branched, the branches minutely scaly. Achene biconvex, obovate, the broadly acute or subrounded apex with a pale, distinct rim extending downward along angles, 1–1.3 mm long (excluding style base), 0.9–1.1 mm wide, surface reticulated at early stages of maturity, at later stages of maturity shallowly reticulated to smooth, the lighter colored cell walls strikingly contrasting with the dark brown cell bodies, shiny, brown to reddish brown at maturity; style base triangular or triangular-sagittate, ca. 1 mm long and as wide at base, light brown, flattened, slightly thickened, smooth on margins; bristles 6, antrorsely barbed, exceeding achene and style base, frequently 1 or 2 rudimentary or shorter than achene body.

Habitat and distribution. Known only from the type collection made on a mountain summit in the Bakhuis Mountains, Surinam.

This is a species of *Rhynchospora* sect. *Pseudoaureae* C. B. Clarke. It is closely related to *R. paraensis* Schrader ex Kunth but differs from that species in having glabrous culms and leaves, the blades only bluntly scabrous on margins; smaller achenes (1–1.3 × 0.9–1.1 mm); a flattened only slightly thickened style base with smooth margins; and longer perianth bristles that are from 1.5 to 2

Figure 3. *Rhynchospora bakhuisensis* M. T. Strong. —A. Habit. —B. Detail of inflorescence panicle branch with spikelets. —C. Spikelet. —D. Spikelet scale. —E. Achene. (Drawn from the holotype, *Florschütz & Maas 2954*, U.)

times longer than those of *R. paraensis*. *Rhynchospora paraensis* differs in having finely pubescent culms and leaf sheaths, the orifice of the leaf sheath pilose; coarsely ciliate leaf blade margins; larger achenes (1.2–1.6 × 1–1.3 mm); a swollen spongy-thickened style base that is antrorsely scabrous on margins at base; and shorter perianth bristles.

Rhynchospora donselaarii M. T. Strong, sp. nov. TYPE: Surinam. Sipaliwini Savanna: wet valley, 27 Aug. 1966, *J. van Donselaar 3618* (holotype, U 210087). Figure 4.

Haec species a congeneris sectionis *Spermodontum* Kükenthal achenio ovato ad oblongo-ovato non profunde biconvexo, laevi, ad basin subsessilem vel brevistipitatam cavitatibus amplis duabus praedito distinguitur.

Slender, rhizomatous perennial; sheathing base of culm 0.8–1.2 mm wide; roots fibrous, brown. Culms slender, ascending, 7–21 cm tall, 0.4–0.8 mm wide, trigonous, finely ribbed, smooth, pale green, glabrous, often branching and rooting from lower nodes. Leaves ascending, basal and cauline, the cauline elongate, surpassing the inflorescence; sheaths finely veined, glabrous, greenish to pale brown, the inner band herbaceous, closed at summit with a membranous U-shaped to truncate, reddish brown orifice, splitting with age; ligule an obscure to very short membranous band at adaxial base of blade (on some blades); blades (0.4–)5–22 cm long, 0.4–0.7 mm wide (folded), 1.2–1.5 mm wide (unfolded), narrowly V-shaped to longitudinally folded, often tightly folded and appearing flattened and 2-sided, narrowly linear, ascending, long-acuminate to apex, finely veined, smooth, pale green, the margins near apex remotely antrorsely scabrous. Inflorescence of (1 to) 2 or 3, remote, lax corymbs of 2 or 3 (to 4) short-pedicelled spikelets, the corymbs 10–20 × 5–8 mm; corymb branches trigonous to compressed-trigonous or sometimes 4-sided and rectangular in cross section, glabrous, the branches and spikelet pedicels each subtended by a tubular prophyll and linear-setaceous bract at base, the lowermost bract linear-lanceolate and long-awned, the upper prophyll smaller, ovate, with a notched apex, the spikelets on pedicels 1–10 mm long, borne singly or in fascicles of 2 or 3 at branch tips. Spikelets ovoid-lanceoloid with acuminate apex, 7–9 × (1.2–)1.3–2 mm, the scales spreading with maturing achenes; scales 7 to 9 per spikelet, lowermost sterile, ovate-lanceolate, narrowly acute to acuminate at apex, sterile basal and lower fertile scales somewhat thickened and coriaceous, pale brown, smooth and sublustrous, with broad scarious margins, upper fertile scales ovate-lanceolate to lanceolate, thin and herbaceous, brown, usually hidden by the lower fertile scales, midcosta pale, very narrow, distinct, prolonged beyond the acute to acuminate apex of the scale as a short awn, lateral nerves very fine, indistinct; fertile scales 3 or 4, 5–7 × 1–3.2 mm; sterile scales 4 or 5 at spikelet base, smaller than the fertile, 2–5 × 1.3–2.6 mm. Flowers perfect, 1 or 2 (to 3) maturing achenes, the distal flowers of a spikelet staminate with abortive pistil; stamens 3, the anthers linear, 1.5–2 mm long, basifixed, thecae parallel, longitudinally dehiscent, apiculate at apex; styles 2-branched, glabrous, the stigmas nearly equaling the length of the unbranched portion. Achene shallowly biconvex, ovate to oblong-ovate, 2–2.3 × 1.8–2 mm, pale brown, minutely scrobiculate, with transversely elliptic smooth area medially on each side, this often with a gray longitudinal stripe or patch medially, the base on each side with 2 large dark-colored cavities just above and lateral to the axis of the subsessile to short-stipitate base, the apex 2-lobed, the lobes forming a cup encircling the style base; style base small, triangular, equaling or shortly exceeding the rim of the apical lobes of the achene; bristles absent.

Habitat and distribution. Known only from the type collection made in the Sipaliwini Savanna, Surinam.

The combination of an inflorescence of lax corymbs; deeply 2-branched style; lack of perianth bristles; and in particular, an essentially smooth achene with a 2-lobed, prolonged cup-like rim at apex that encircles a small triangular style base, places this new species in *Rhynchospora* sect. *Spermodontes*. Among species in that section, *R. donselaarii* can be distinguished by its ovate to oblong-ovate, shallowly biconvex, essentially smooth achenes with two large dark-colored cavities just above and lateral to the axis of the subsessile to short-stipitate base. The type collection of this species was cited as *R. brevirostris* Grisebach by Lindeman and van Donselaar (1971). However, it differs from that species in its larger spikelets (7–9 × (1.2–)1.3–2 mm vs. 3–4 × 0.8–1.4 mm) and larger ovate to oblong-ovate shallowly biconvex achenes (2–2.3 × 1.8–2 mm vs. 1.2–1.5 × 1–1.3 mm). Furthermore, the achenes of *R. brevirostris* are rounded-obovate, thickly biconvex, have a thickened tongue-like stipe, and bear two cellular swellings on either side at base.

The new species is named in honor of its collector, Johannes van Donselaar, who studied savanna ecosystems in Surinam. At the time he collected

Figure 4. *Rhynchospora donselaarii* M. T. Strong. —A. Habit. —B. Detail of inflorescence corymb branch with spikelets. —C. Spikelet. —D. Spikelet scale. —E. Achene (lateral view). —F. Achene (dorsal view). (Drawn from the holotype, *van Donselaar 3618*, U.)

this, he was an ecologist with the Institute of Systematic Botany, Utrecht (U), The Netherlands.

Rhynchospora pubisquama M. T. Strong, nom. et stat. nov. Replaced synonym: *Rhynchospora cephalotes* var. *angustifolia* Uittien, Rec. Trav. Bot. Néerl. 30: 188. 1933, not *Rhynchospora angustifolia* Palla, Denkschr. Akad. Wien, Math.-Nat. 79: 193. 1908. TYPE: Surinam. Upper Gran Rio, 10 Oct. 1910, *Hulk 346* (lectotype, selected here, U 031820).

Habitat and distribution. Rocky openings, granitic outcrops, and rocky savannas or scrub. Occurs on Tafelberg Mountain (southern end of Emma Keten mountain range) and in the Wilhelmina mountains of Surinam, and at Pararé rapids along the Arataye River on a slope of an inselberg and on Mt. Nouragues in the Balenfois Mountains of French Guiana.

With its combination of contracted inflorescence panicles of crowded spikelets; thickly herbaceous middle and lower spikelet scales; 2-branched style; well-developed antrorsely barbed perianth bristles; and cellular-reticulate achene surface, *Rhynchospora pubisquama* is a species of *R.* sect. *Cephalotae* Kükenthal. It is closely related to *R. cephalotes* (L.) Vahl and has been described as a variety of that species (*R. cephalotes* var. *angustifolia*) by Uittien (1933). It differs from *R. cephalotes* in having narrower leaf blades (2.5–6(–10) mm wide); a narrow, oblong inflorescence; puberulent spikelet scales; semi-glossy, shallowly reticulate achenes; and a triangular-lanceolate style base that has a narrow rim between its base and the apex of the achene, while *R. cephalotes* has broader leaf blades ((4–)5–15 mm wide); an ovoid to oblong-ovoid, pyramidal, or subglobose inflorescence; glabrous spikelet scales; a transversely rugulose-reticulate achene; and a lanceolate-attenuate style base that overlaps the shoulders of the achene at its base. In habit, *R. pubisquama* is very similar to *R. imeriensis* (Kükenthal) W. Thomas, which is endemic to the Venezuelan Guayana region of South America and was also previously described as a variety of *R. cephalotes* (Thomas, 1996). However, it differs from that species in having narrower leaves (2.5–6(–10) mm wide); puberulent spikelet scales; semi-glossy, shallowly cellular-reticulate achenes; and triangular-lanceolate style base; while *R. imeriensis* has broader leaf blades in the same range as *R. cephalotes*; glabrous spikelet scales that are at most finely scabrous-pubescent at the apex; transversely rugulose-reticulate achenes; and a lanceolate-attenuate style base. Because of the range of characters in *R. pubisquama* that differ consistently from other closely related species in *R.* sect. *Cephalotae*, I feel that this taxon is best treated as distinct from *R. cephalotes*.

At the species level, it is necessary to give this plant a new epithet different from the varietal epithet of the basionym (*angustifolia*) since that epithet is already in use for another species of *Rhynchospora*. The epithet "*pubisquama*" alludes to the puberulent spikelet scales of the species.

Paratypes. SURINAM. Expeditie naar Wilhelminagebergte, 5 Aug. 1926, *Stahel 585* (U); Tafelberg (Table Mountain), Grace Falls, Arrowhead Basin, among rocks, 625 m, 26 Aug. 1944, *Maguire 24493* (F, MO, U, US); 1 km SE Savanna No. 8, rocky dry opening in *Clusia* bush, 780 m, 29 Aug. 1944, *Maguire 24559* (F, U, US). FRENCH GUIANA. Fleuve Approuague, Rivière Arataye, saut Pararé, pente d'un inselberg, zone de transition, en bordure d'une source, 22 Oct. 1978, *Sastre 6221* (CAY); Montagne des Nouragues, Bassin de l'Arataye, sommet, Fourré isolé de savanne roche, 04°03′N, 52°42′W, 15 Aug. 1988, *Sarthou 408* (CAY).

Rhynchospora rupicola M. T. Strong, sp. nov. TYPE: Surinam. In montibus, qui dicuntur Emmaketen, rock savanna on S side of top, SW of Grote Hendriktop, ca. 935 m, 20 Aug. 1959, *A. Daniëls & F. Jonker 998* (holotype, U 276785; isotype, US). Figure 5.

Haec species a congeneris sectionis *Psilocaryae* (Torrey) C. B. Clarke culmis gracilibus (1.0–1.3 mm latis), inflorescentiae contractae ramis lateralibus brevibus et spiculis 4–5 mm longis solitariis vel fasciculatis ad apices ramorum atque achenio in rostrum apice truncatum basi lunatum elobatum desinente distinguitur.

Slender perennial; rhizome short, the culms borne singly or sometimes 2 or 3 together from nodes of the rhizome; sheathing base of culm 4–6 mm wide; roots fibrous. Culms slender, ascending, 4–7 dm tall, 1–1.3 mm wide, trigonous, with concave sides, finely ribbed, smooth, green, glabrous except for the hirsute apex just below the inflorescence. Leaves ascending, primarily basal, 6 to 8, elongate, surpassing the inflorescence; sheaths finely veined, hirsute to glabrescent, greenish to pale brown, the inner band herbaceous, closed at summit with a membranous U-shaped to truncate orifice, splitting with age; ligule an obscure to very short membranous band at adaxial base of blade (on some blades); blades to 8 dm long, 2–4 mm wide, flattened to subfolded, narrowly linear, ascending to flaccid, long-acuminate to apex, finely veined, smooth, green to pale brown, the margins and abaxial midcosta remotely scabrous and beset with elongate, ascending trichomes. Inflorescence of 1 or 2 approximate to subremote, compact, cor-

Figure 5. *Rhynchospora rupicola* M. T. Strong. —A. Habit. —B. Detail of inflorescence panicle branch with spikelets. —C. Spikelet. —D. Spikelet scale. —E. Achene. (Drawn from the holotype, *Daniëls & Jonker 998*, U.)

ymbose or pyramidal panicles from the upper sheathing bracts, the panicles (1.5–)2–4 cm diam.; sheathing bracts 2 or 3, leaf-like, the lowermost elongate, to 7 dm long, 2–3 mm wide, greatly overtopping the inflorescence; panicle branches short, trigonous to subcompressed, hirsute particularly on margins, the branches and spikelet pedicels each subtended by a tubular prophyll and linear bract at base, the lower bract ovate-acuminate and long-awned, the upper prophyll smaller, ovate, with a notched apex, the spikelets short-pedicelled, appearing sessile, borne singly or in fascicles of 2 or 3 at branch tips. Spikelets ovoid-ellipsoid, 50 to 150 per panicle, 4–5 × 1.3–1.8 mm; scales 8 to 10 per spikelet, thinly herbaceous to submembranous marginally, whitish to stramineous or light brown, with a distinct narrow, green midcosta, prolonged as an antrorsely scabrous awn below the acute to acuminate, emarginate apex, the sides indistinctly veined; fertile scales ovate to ovate-elliptic or ovate-lanceolate (distal scales), 6 to 7, 3–4 × 1.6–2 mm; sterile scales ovate, 2 to 3 at base, smaller than the fertile, 2–2.5 × 1.2–1.4 mm. Flowers perfect, 1 or 2 (to 3) maturing achenes, the distal flowers of a spikelet staminate with abortive pistil; stamens 3, the anthers linear, 1.5–2 mm long, basifixed, thecae parallel, longitudinally dehiscent, apiculate at apex; styles 2-branched, glabrous, the stigmas 1/2 to nearly equaling the length of the unbranched portion, minutely scaly. Achene biconvex, obovate, 1–1.3 mm long (excluding style base), 1.1–1.2 mm wide, transversely rugulose with a short-stipitate, reddish cellular-reticulate base, stramineous to light brown, shiny; style base triangular, 0.7–1 mm long, as wide as to slightly narrower than the achene body at its base, truncate to rounded or slightly emarginate at apex, lunate to somewhat shallowly lobed at junction with achene apex, whitish, spongy, with a granular or obscurely cellular-reticulate surface; bristles absent.

Habitat and distribution. Occurs on granitic outcrops, balds, and rocky savannas or scrub on mountain summits in the Kanuku and Kamoa mountain ranges of Guyana and in the Emma Keten and Bakhuis mountain ranges of Surinam.

Rhynchospora rupicola is a species of *R.* sect. *Psilocarya* (Torrey) C. B. Clarke as circumscribed by Kükenthal (1949, 1950). It is allied to the group of species in that section that are rhizomatous perennials (e.g., *R. velutina* (Kunth) Böckeler). With its slender culms, narrow flattened leaf blades, and contracted corymbose panicles bearing some spikelet fascicles at branch tips, *R. rupicola* might seem to be best placed in the closely allied *R.* sect. *Luzuliformes* Kükenthal. However, species in that section typically have inflorescence panicles that are very small with densely fascicled spikelets and little lateral branching evident. Although the inflorescence panicles of *R. rupicola* are contracted, there is lateral branching clearly evident from the main axis, and the inflorescence is more characteristic of the more open corymbose inflorescence panicles of perennial species of *R.* sect. *Psilocarya*. There are also distinct differences in the style base between species of *R.* sect. *Luzuliformes* and the perennial species of *R.* sect. *Psilocarya* (including *R. rupicola*). Achenes of species of *R.* sect. *Luzuliformes* bear a depressed-trigonous style base that is decurrent on the margins of the achene down to its base forming a channel along the achene margins. Style bases of the perennial species of *R.* sect. *Psilocarya* are triangular and the lobed or lunate base is at most shortly decurrent on the shoulders of the achene, and does not form a channel along the achene margins, characteristic of those of *R. rupicola*. Because of the similar characteristics of *R. rupicola* to perennial species of *R.* sect. *Psilocarya*, I feel that it is best circumscribed as a species of that section.

The epithet alludes to the rocky habitat the species occurs in.

Paratypes. GUYANA. **U. Takutu–U. Essequibo Region:** NW Kanuku Mountains, top of Nappi Mountain, 12 km S of Nappi Village, elfin forest patches, among granite balds, 03°18′N, 59°33′W, 750–900 m, 8 Feb. 1993, *B. Hoffman 3572* with *R. Foster* (BRG, K, MO, NY, U, US); Kamoa Mountains, 2 km N of camp on Kamoa River, scrub forest on granitic outcroppings, 01°32′N, 58°50′W, 520 m, 9 Nov. 1996, *D. Clarke 2993* (BRG, MO, NY, US); Rewa River, summit of unnamed peak, 5.6 km W of camp, medium canopy semi-open forest on brown sand and scrub forest on granitic outcroppings, 02°58′N, 58°38′W, 400 m, 19 Feb. 1997, *D. Clarke 3676* (BRG, K, MO, NY, US). SURINAM. Blanche Marievallen, Nickerierivier, Lands Bosbeheer, 20 June 1965, *P. Maas & J. Tawjoeran 10930* (U).

Acknowledgments. This paper is number 39 in the Smithsonian Institution's Biological Diversity of the Guianas Program publication series. A floristic treatment of the Cyperaceae (sedges) for the *Flora of the Guianas* is in preparation by the author and collaborators. I thank Cathy Pasquale for the superb illustrations; Robert Kral (BRIT), Dan Nicolson (US), and Wayt Thomas (NY) for reviewing the manuscript; Roy Gereau (MO) for reviewing the Latin diagnoses; Christian Feuillet (US) for information on localities in French Guiana; and curators at CAY, F, MO, NY, and U for loan of specimens.

Literature Cited

Kükenthal, G. 1949. Vorarbeiten zu einer Monographie der Rhynchosporideae. Bot. Jahrb. 74(1): 375–509.

———. 1950. Vorarbeiten zu einer Monographie der Rhynchosporideae. Bot. Jahrb. 75(1): 90–126, (2): 127–195.

Lindeman, J. C. & J. Van Donselaar. 1971. Taxonomy, ecology, and distribution of *Rhynchospora* (Cyperaceae) in Suriname. Acta Bot. Neerl. 20: 428–450.

Thomas, W. W. 1996. Notes on capitate Venezuelan *Rhynchospora* (Cyperaceae). Brittonia 48: 481–486.

Uittien, H. 1933. Cyperaceae Surinamensis novae vel criticae. Recueil Trav. Bot. Néerl. 30: 185–191.

Rubiacearum Americanarum Magna Hama Pars IV: New Taxa and Combinations in *Elaeagia* and *Warszewiczia* (Rondeletieae) from Mexico, Central America, and Colombia

Charlotte M. Taylor

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
Charlotte.Taylor@mobot.org

ABSTRACT. The new species *Elaeagia chiriquina* of western Panama and *E. glossostipula* of western Panama and adjacent eastern Costa Rica, described and illustrated here, have been confused with several species of *Elaeagia*, but can be distinguished by details of the stipules, calyx, and corolla. *Elaeagia uxpanapensis* Lorence of Oaxaca, Mexico, is here transferred to *Warszewiczia* based on details of its flower and fruit morphology. This species is also represented by populations disjunct in Costa Rica and northwestern Colombia; these southern populations differ in their larger fruits, and are here separated as *W. uxpanapensis* subsp. *meridionalis*.

RESUMEN. Las especies nuevas *Elaeagia chiriquina* del oeste de Panamá y *E. glossostipula* del oeste de Panamá y el este adyacente de Costa Rica, que se describen e ilustran aquí, se han confundido con varias especies de *Elaeagia*, pero se distinguen por detalles de las estípulas, cáliz y corola. *Elaeagia uxpanapensis* Lorence de Oaxaca, México, aquí se transfiere a *Warszewiczia* basado en detalles de la morfología de las flores y los frutos. Esta especie se encuentra en poblaciones disjuntas en Costa Rica y el noroeste de Colombia; estas poblaciones sureñas se distinguen por los frutos más grandes, y aquí se separan en *W. uxpanapensis* subsp. *meridionalis*.

Key words: Central America, Colombia, *Elaeagia*, Mexico, Neotropics, Rondeletieae, Rubiaceae, *Warszewiczia*.

The neotropical genus *Elaeagia* Weddell (Rondeletieae; Robbrecht, 1993) comprises about 15 species of small to medium-sized trees that grow in regions of wet climate, usually at middle elevations (500–1500 m), from Central America to Venezuela and Bolivia. This genus has not been treated taxonomically as a whole in this century, although Steyermark (1964) provided a summary of the species of northern South America. *Elaeagia* is characterized by its distinctive stipules (see below); its terminal, cymose to paniculate inflorescences that typically are ebracteate or have reduced bracts; its flowers that are homostylous, protrandrous, and diurnal; its calyx limbs that are truncate or sinuate to five-lobed; its campanulate to tubular corollas with their tubes usually shorter than the five lobes, which are convolute to subvalvate (Taylor & Hammel, 1993) in aestivation; its stamens exserted on well-developed filaments that are typically densely pubescent in their lower portions, with this pubescence making the corolla appear barbate in the throat; its two or rarely three linear stigmas; its woody, subglobose to ellipsoidal, capsular fruits that are loculicidal through their tops, usually opening only in the part distal to the insertion of the calyx limb; and its numerous small, angled seeds. In some species, the dehiscent apical portion of the capsule elongates during development to form a beak similar to that of the capsules of some species of *Hedyotis* L., so the fruits appear only partially inferior (Fig. 1E).

The stipules of *Elaeagia* are unusual: on young buds they are complanate and oriented perpendicular to the line formed by the petioles of the subtending leaves, in contrast to the most common stipule arrangement in the Rubiaceae, in which the stipules are oriented parallel to the subtending petioles. In *Elaeagia* the stipules initially are coherent or fused in a completely closed structure (Fig. 1C), and as the leaves emerge this structure splits into two *intra*petiolar portions (Fig. 1H); this condition also contrasts with the most common stipule arrangement in the Rubiaceae, which is to have the stipules *inter*petiolar or separating into two *inter*petiolar portions. (Among neotropical Rubiaceae, only *Capirona* Spruce of the Amazon basin has a stipule arrangement similar to that of *Elaeagia*, with the young stipules of *Capirona* also fused into a closed structure that splits into two interpetiolar portions.) There are two distinct stipule forms within *Elaeagia*: in some species [e.g., *E. myriantha* (Standley) C. M. Taylor & Hammel, *E. nitidifolia* Dwyer, *E. pastoense* Mora] the two stipules are usu-

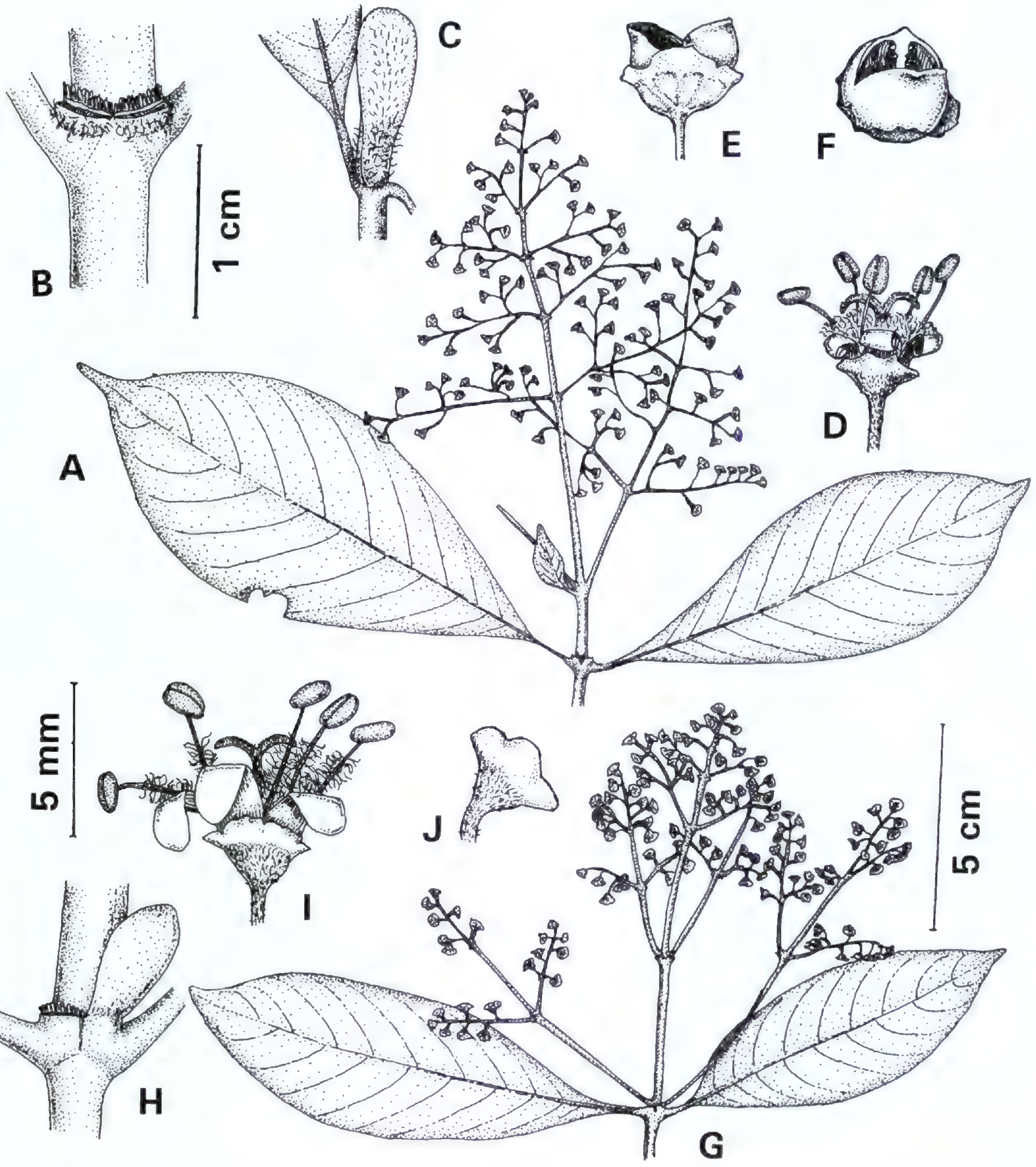


Figure 1. A–F, *Elaeagia glossostipula* C. M. Taylor. —A. Flowering branch. —B. Stem node after stipule limb has fallen. —C. Stem apex with stipule limb still attached. —D. Flower at anthesis. —E. Capsule, side view. —F. Capsule, oblique top view. G–J, *Elaeagia chiriquina* C. M. Taylor. —G. Flowering branch. —H. Stem node with stipule limb partially fallen. —I. Flower at anthesis. —J. Flower after corolla and style have fallen, showing variation in shape of the calyx limb lobing. A, G to 5-cm scale; B, C to 1-cm scale; all others to 5-mm scale. A, based on *McPherson 13557*; B, D, based on *McPherson & Aranda 10075*; C, E, F, based on *Santamaría & Lara 1005*; G, I, J, based on *McPherson 12022*; H, based on *McPherson & Merello 8266*.

ally 1 cm long or shorter and fully persistent after separating, while in other species (e.g., *E. auriculata* Hemsley, *E. karstenii* Standley) the stipules are small to long, to 5 cm long, and after splitting the two portions are then partially caducous (Fig. 1H) with the apical portion falling away leaving two short, persistent, intrapetiolar, truncate bases that often bear well-developed persisting colleters (Fig. 1B).

Another distinctive characteristic of many species of *Elaeagia* is the presence of resin on the apical buds and sometimes coating the young inflorescences. A few species do not appear to have any resin while a few species produce it copiously, in

particular *E. pastoense* Mora of Panama and Colombia and *E. utilis* (Goudot) Weddell of Colombia and Ecuador. Mora-Osejo (1977) documented the anatomy of the secretory structures of *E. pastoense* and the harvest and use of its resin in Colombia, where it is collected from wild trees, heated, stretched into thin sheets, and applied as a wood varnish for handicrafts. Currently the resin is destructively collected from wild plants, but development of sustainable-use harvesting is under study in western Colombia (García S., 1999, pers. comm.).

The neotropical genus *Warszewiczia* Klotzsch (also Rondeletieae) comprises about five species of medium-sized to large trees that grow in wet lowland to middle-elevation forests from Mexico to Bolivia. *Warszewiczia* is similar to *Elaeagia* in its tree habit, its inflorescence structure and position, its five-lobed calyx limbs and corollas, its stamens that are exserted on pubescent filaments, its linear exserted stigmas, and its woody, similar-sized capsular fruits that open from the top. However, *Warszewiczia* differs from *Elaeagia* by its generally triangular, interpetiolar stipules that are typically convolute in bud and quickly and completely caducous; its protogynous flowers; its imbricate corolla lobe aestivation; and its septicidal fruits. Although *Warszewiczia* is often also characterized by bearing brightly colored calycophylls (i.e., enlarged, petaloid, white or colored calyx lobes that are produced, usually singly, on one or a few flowers in each cymule), these calycophylls are often deciduous before the fruits develop and thus not present on infructescences. The calycophylls appear to be completely absent from some inflorescences, individuals, or populations of calycophyllous species (Taylor, 1997), and the *Warszewiczia* species treated below appears to lack them completely. Another feature of *Warszewiczia* that is not always noted in descriptions is the occasional production of resin at the vegetative apices (Taylor, 1997). *Warszewiczia* has not been treated taxonomically as a whole in this century.

Elaeagia chiriquina C. M. Taylor, sp. nov. TYPE: Panama. Bocas del Toro: vicinity of Cerro Colorado mine above San Felix, along trails N of road along continental divide, 8°35′N, 81°50′W, 1500 m, 26 Jan. 1988, *G. McPherson 12022* (holotype, MO-3635060). Figure 1G–J.

Haec species a congeneris caulium apicibus saepe resinosis, stipularum 6–8 mm longarum caducarum post abscissionem basibus truncatis intrapetiolaribus duabus 1–2 mm altis remanentibus, foliis ellipticis 5–16 × 2.5–5.5 cm acutis vel breviacuminatis, limbo calycino lobato 1–1.2 mm longo atque lobulis corollinis ca. 3 mm longis distinguitur.

Trees to 11 m tall; stems glabrous, with vegetative apices frequently resinous. Leaves 5–16 × 2.5–5.5 cm, elliptic, chartaceous, glabrous, at base cuneate to acute, at apex acute to shortly acuminate; secondary veins 9 to 10 pairs, not looping to interconnect, without domatia, adaxially costa plane to prominulous and secondary and minor venation plane, abaxially costa and secondary veins plane to prominulous and minor venation plane; petioles 5–12 mm long; stipules 6–8 mm long, ligulate to obovate, rounded, glabrous except hirtellous in lower half, caducous leaving persistent and truncate intrapetiolar bases 1–2 mm high. Inflorescences 8–11 × 5–10 cm, pyramidal, puberulous to hirtellous, ebracteate, with secondary axes branched to several orders; peduncles 3; pedicels 1.5–3.5 mm long. Flowers with hypanthium ca. 1 mm long, turbinate; calyx limb 1–1.2 mm long, glabrous, 5-lobed for ca. half its length, lobes rounded to obtuse; corolla white, externally puberulous at least near base, tube ca. 1 mm long, lobes 5, ca. 3 mm long, ligulate, rounded; filaments densely villosulous in lower portion, anthers ca. 1 mm long; stigmas 2, ca. 1.2 mm long. Fruits not seen.

Distribution, habitat, and phenology. Wet forest at 1500–1750 m in western Panama; collected with flowers in January, with flower buds in February.

This new species is distinguished by the combination of its vegetative apices that are frequently resinous, stipules that are 6–8 mm long and caducous leaving truncate bases 1–2 mm high, elliptic leaves 5–16 × 2.5–5.5 cm and acute to shortly acuminate at apex, calyx limbs 1–1.2 mm long and lobed for about half their length, and corolla lobes ca. 3 mm long. The size, shape, and caducous limb of the stipules distinguish *E. chiriquina* from the other *Elaeagia* species known from Central America. The specific epithet refers to the known geographic distribution of this species, in the Chiriquí region of western Panama.

Paratypes. PANAMA. **Chiriquí:** along trail to Cerro Pate Macho, 8°49′N, 82°24′W, *McPherson & Merello 8266* (MO, PTBG).

Elaeagia glossostipula C. M. Taylor, sp. nov. TYPE: Panama. Bocas del Toro: along old pipeline road from continental divide, 8°48′N, 82°15′W, 900 m, 27 Dec. 1986, *G. McPherson & J. Aranda 10172* (holotype, MO-3618289; isotype, PTBG-7037). Figure 1A–F.

Haec species a congeneris caulium apicibus saepe resinosis, stipularum 18–40 mm longarum caducarum post

abscissionem basibus truncatis intrapetiolaribus duabus 1.5–2 mm altis remanentibus, foliis ellipticis 8–27 × 2.5–11 cm acutis vel breviacuminatis, limbo calicino lobato 0.8–1 mm longo atque lobulis corollinis 2–2.2 mm longis distinguitur.

Trees to 15 m tall; stems puberulous, with vegetative apices frequently resinous. Leaves 8–27 × 2.5–11 cm, obovate to oblanceolate, papyraceous, adaxially glabrous, abaxially puberulous to hirtellous, at base cuneate to acute, at apex acute to shortly acuminate; secondary veins 9 to 17 pairs, not looping to interconnect, without domatia, adaxially costa plane to prominulous, secondary veins plane, and finely reticulated minor venation prominulous, abaxially costa plane to prominulous and secondary and minor venation prominulous; petioles 5–15 mm long; stipules 18–40 mm long, ligulate to oblanceolate, rounded, glabrous except puberulous to villosulous and usually also hirsute near base, caducous leaving truncate intrapetiolar bases 1.5–2 mm high. Inflorescences 13–20 × 12–20 cm, pyramidal, hirtellous, with secondary axes branched to several orders; peduncles 3; bracts reduced; pedicels 1.5–5 mm long. Flowers with hypanthium 0.8–1 mm long, turbinate to cupuliform; calyx limb 0.8–1 mm long, puberulous to glabrous, 5-lobed for about half its length, lobes obtuse to truncate; corolla white, externally glabrous, tube 0.5–0.8 mm long, lobes 5, 2–2.2 mm long, ligulate, rounded; flaments densely villosulous in basal portion, anthers ca. 1 mm long; stigmas 2, ca. 1.2 mm long. Fruits 3.5–4 mm diam., subglobose, beak (i.e., apical portion above insertion of calyx limb) enlarged after anthesis, eventually longer than persistent calyx limb.

Distribution, habitat, and phenology. Wet forest at 900–1300 m in western Panama and adjacent eastern Costa Rica; collected with flowers in January, March, November, and December, with fruits in January, March, September, and December.

This new species is distinguished by the combination of its vegetative apices that are frequently resinous; its stipules 18–40 mm long, usually hirsute near the base, and caducous leaving truncate intrapetiolar bases 1.5–2 mm high; its elliptic leaves 8–27 × 2.5–11 cm and apically acute to short-acuminate; its calyx limbs 0.8–1 mm long and 5-lobed for about half their length; and its corolla lobes 2–2.2 mm long. The form, size, and caducous limb of the stipules together with the leaves that are acute to cuneate at the base distinguish this from the other species of *Elaeagia* known from Central America, except *E. karstenii* Standley. The specific epithet refers to the distinctive shape of the stipules. *Elaeagia karstenii* differs from *E. glossostipula* by its longer corolla lobes (2.5–4 mm long), its stipules that are hirtellous to villosulous throughout but never hirsute near the base, and its obovate leaves 13–38.5 × 6.5–21 cm.

Paratypes. COSTA RICA. **Limón:** región sureste del Lago Dabagri, cruzando las filas hacia Telire (Laguna Tiestos y Fila de Los Aguacatillos), *L. D. Gómez et al. 23196* (MO). **Puntarenas:** cantón de Parrita, cuenca del Naranjo y Paquetá, fila Chonta, La Virgen, 9°35′N, 84°09′W, *Morales & Abarca 6284* (INB, MO). PANAMA. **Bocas del Toro:** Fortuna Dam region, along road to Chiriquí Grande, 8°48′N, 82°10′W, *McPherson 8670* (MO, PMA); Fortuna Dam region, along continental divide trail bordering Chiriquí, 8°45′N, 82°15′W, *McPherson & Aranda 10075* (MO); trocha que comunica con la cima de Cerro Guabo, *Santamaría & Lara 1005* (MO, PMA). **Bocas del Toro-Chiriquí Border:** Fortuna Dam region, along continental divide trail, 8°45′N, 82°15′W, *McPherson 13550* (MO, PTBG), *13557* (MO). **Chiriquí:** NE del campamento de Fortuna (Hornito), sitio de presa, después de caseta de excavaciones geológicas, 8°45′N, 82°15′W, *Correa et al. 2885* (MO, PMA); NE del campamento de Fortuna (Hornito), sitio de presa, 8°45′N, 82°15′W, *Garibaldi et al. 2885* (MO, PMA); road from Fortuna Lake to Chiriquí Grande, 5 km along track to just S of continental divide, 8°49′N, 82°12′W, *Hampshire & Whitefoord 428* (BM, F, MO, PMA); vicinity of Fortuna Dam, along trail near Río Hornito, 8°45′N, 82°15′W, *McPherson 9902* (BM, DUKE, MO).

Warszewiczia uxpanapensis (Lorence) C. M. Taylor, comb. nov. Basionym: *Elaeagia uxpanapensis* Lorence, Bol. Soc. Bot. México 46: 66, fig. 1. 1983. TYPE: Mexico. Oaxaca: municipio de Matías Romero (Zona de Uxpanapa), a 2 km SE del aserradero La Floresta sobre el camino a Río Verde, a 15 km S de Esmeralda, 250 m, 25 May 1981, *T. Wendt, S. Koch, A. Villalobos & J. García 3299* (holotype, MEXU; isotypes, CHAPA not seen, MO-3273136).

This species from wet forest at 170–430 m in southern Mexico was originally described based on specimens with inflorescences bearing only flower buds and infructescences with only young fruits. The flower buds on the collections studied by Lorence have the lobes nearly open in aestivation, so their arrangement in bud is not clearly evident, and the open flowers variously have the anthers and stigmas equally well developed, the stigmas better developed than the anthers, or the anthers relatively more developed than the stigmas, so that most or all of the buds appear to have opened prematurely as the specimens were dried. The young capsules of the fruiting collections are dehiscent, apparently loculicidally, through a small apical opening, and the stipules are caducous and lacking on the specimen except those at the bases of some of the inflorescences. The stipules produced at the

bases of the inflorescences are atypical in many plants of Rubiaceae and thus not taxonomically informative.

In general aspect the plants seen by Lorence resemble several species of *Chimarrhis*, *Warszewiczia schwackei* K. Schumann of the Amazon basin, and *Elaeagia myriantha*; without more information, the placement of this species in *Elaeagia* was not counterindicated. However, more collections of this species are now available and show that its stipules are interpetiolar, triangular, and convolute in aestivation, that its flowers are strongly protogynous, and that its capsules are primarily septicidal and apparently only secondarily and shortly loculicidal. As noted above, these features all characterize *Warszewiczia* and distinguish it from *Elaeagia*; therefore, *E. uxpanapensis* is here transferred to *Warszewiczia*. The arrangement of the corolla lobes in bud is difficult to discern but apparently open, though the lobes overlap weakly on their sides in a manner consistent with a convolute arrangement.

Within *Warszewiczia*, *W. uxpanapensis* is similar in general aspect and inflorescence arrangement to *W. schwackei* of the Amazon basin; *W. schwackei* can be distinguished from *W. uxpanapensis* by its white calycophylls (though these apparently are not produced in all inflorescences), its calyx limbs 0.2–0.3 mm long, its corolla lobes 0.6–1 mm long, and its distribution at low elevations in the central and western Amazon basin. (The corresponding characters of *W. uxpanapensis* are presented below.)

Recent exploration has expanded the known range of *Warszewiczia uxpanapensis* to central Costa Rica and northwestern Colombia. The plants of all these regions occupy comparable habitats and cannot be distinguished by their vegetative organs, inflorescences, and flowers, and thus are here considered conspecific. Several species of *Psychotria* L. subg. *Psychotria* show similarly large range disjunctions without marked morphological differentiation; in some cases the disjunct populations have been treated as a single wide-ranging species, and in other cases some morphological differences are evident and infraspecific taxa have been recognized (Hamilton, 1989). Based on the lack of collections of *W. uxpanapensis* from northern Central America and an apparent difference in fruit size between Mexican plants and those of Costa Rica and Colombia, two subspecies are recognized here. The rank of subspecies is chosen because these two populations are distinct in one quantitative feature and fully allopatric (Stuessy, 1990).

Warszewiczia uxpanapensis subsp. **meridionalis** C. M. Taylor, subsp. nov. TYPE: Costa Rica. Alajuela: Reserva Forestal de San Ramón, laderas al este de la estación, 10°13′N, 84°36′W, 2 May 1987, *G. Herrera Ch. 600* (holotype, MO-429761; isotypes, COL-394796, F).

Haec subspecies a subspecie typica capsula 2.5–3 mm [vs. 1.5–2 mm] longa distinguitur.

Trees to 40 m tall; stems hirtellous to glabrescent. Leaves 6.5–21 × 3.2–12 cm, elliptic to obovate or oblanceolate, chartaceous, adaxially glabrous, abaxially glabrous except with a line of pilose pubescence along each side of costa, at base cuneate to obtuse, at apex obtuse to acute; secondary veins 7 to 9 pairs, not looping to interconnect, with pilosulous domatia in axils, adaxially costa plane to a little sulcate, secondary veins plane, and reticulated minor venation plane to prominulous, abaxially costa prominent, secondary veins prominulous, and minor venation plane to prominulous; petioles 1–2 cm long; stipules 9–13 mm long, interpetiolar, triangular to ovate, acute, glabrous, caducous. Inflorescences 6–15 × 5–15 cm, terminal and sometimes also produced in distalmost leaf axils, hirtellous to glabrescent, paniculate with higher-order axes spiciform; peduncles 1.5–3.5 cm long; bracts to 0.5 mm long. Flowers sessile in glomerules of 2 to 7; hypanthium ca. 1 mm long, turbinate, hirtellous to glabrous; calyx limb 0.8–1 mm long, glabrous, sinuate to shallowly lobed, lobes deltoid, without calycophylls; corolla funnelform, green, externally glabrous, tube ca. 0.8 mm long, lobes 5, ca. 2 mm long, ligulate, obtuse to rounded; anthers ca. 0.5 mm long, exserted; stigmas ca. 1 mm long, oblong. Fruits 2.5–3 × 2.5 mm; seeds 0.2–0.5 mm long.

Distribution, habitat, and phenology. Wet forest at 600–1300 m, central Costa Rica and northwestern Colombia; collected in flower in March and May, in fruit in March through May, July, and September through November.

The specific epithet refers to the relatively southern range of this subspecies. These plants have been confused in Costa Rica and Colombia with *Elaeagia myriantha*; *E. myriantha* can be distinguished quickly from *Warszewiczia uxpanapensis* by its stipules that are complanate in bud and persistent as two rounded to truncate, intrapetiolar segments. This new subspecies can be distinguished from the typical subspecies as follows:

KEY TO THE SUBSPECIES OF *WARSZEWICZIA UXPANAPENSIS*

1. Capsules 1.5–2 mm long; plants of Oaxaca, Mexico, growing at 170–430 m . . . subsp. *uxpanapensis*
1′. Capsules 2.5–3 mm long; plants of Costa Rica

and Colombia, growing at 600–1300 m . . . . . subsp. *meridionalis*

Paratypes. COLOMBIA. **Antioquia:** municipio de San Luis, Autopista Medellín–Bogotá, sector Río Samaná-Río Claro, *J. J. Hernández et al. 522* (HUA, MO); municipio de San Luis, quebrada La Cristalina, 6°N, 74°45′W, *J. G. Ramírez & Cárdenas L. 754* (JAUM, MO), *844* (JAUM, MO), sector SE, *J. G. Ramírez & Cárdenas L. 1886* (JAUM, MO). COSTA RICA. **Alajuela:** San Carlos, Peñas Blancas, *Haber & Bello C. 1928* (MO); Monteverde Reserve, Peñas Blancas river valley, Atlantic slope, 10°20′N, 84°43′W, *Haber ex Bello C. 5687* (F, MO), *Haber & Bello 7088* (F, MO); Reserva Biológica Monteverde, Río Peñas Blancas, Finca Beto, 10°29′N, 84°44′W, *Haber & Bello 7592* (CR, MO); cantón de San Ramón, Reserva Forestal San Ramón, Cedral de Miramar, 2.5 km O, en el límite de la Reserva, 10°14′N, 84°39′W, *Q. Jiménez et al. 1534* (CR, MO). **Heredia:** Parque Nacional Braulio Carrillo, sendero del transecto, immediately to right of trail one half hour below refugio at 1070 m, 10°17′N, 84°05′W, *Boyle 1315* (F, MO). **Limón:** Parque Internacional La Amistad, quebrada Crori, Croriña, 9°25′N, 82°59′W, *A. Chacón 252* (CR, F, MO). **San José:** cantón de Tarrazú, Faja Costeña del Valle de Parrita, Concepción de Tarrazú, en la Fila San Isidro, camino a San Isidro, 9°34′N, 84°05′W, *Morales & Ureña 3754* (CR, F, MO).

Acknowledgments. I thank R. E. Gereau for preparation of the Latin diagnoses; the curators and staff of BM, COL, CR, DUKE, F, HUA, INB, JAUM, MEXU, and PTBG for access to specimens; Mireya Correa and David Lorence for discussions and providing information; and Robin Foster, Tyana Wachter, and a grant from the Andrew Mellon Foundation to the Field Museum of Natural History for support for travel to that institution.

Literature Cited

García S., L. 1999. Contribución a la descripción taxonómica de *Elaeagia pastoense* Mora (Rubiaceae), caracterización de sus poblaciones y estudio preliminar de su flora asociada [Abstract]. Libro de Resumenes, Primer Congreso Colombiano de Botánica, Universidad Nacional de Colombia, Santafé de Bogotá, p. 80.

Hamilton, C. W. 1989. A revision of Mesoamerican *Psychotria* subg. *Psychotria* (Rubiaceae). Ann. Missouri Bot. Gard. 76: 67–111, 386–429, 886–916.

Mora-Osejo, L. E. 1977. El barniz de Pasto. Caldasia 11: 5–31.

Robbrecht, E. 1993. Supplement to the 1988 outline of the classification of the Rubiaceae. Opera Bot. Belg. 6: 173–196.

Steyermark, J. A. 1964. *Elaeagia. In:* B. M. Maguire & Collaborators, Flora of the Guayana Highlands. Part VI. Mem. New York Bot. Gard. 12: 186–192.

Stuessy, T. F. 1990. Plant Taxonomy, the Systematic Evaluation of Comparative Data. Columbia Univ. Press, New York.

Taylor, C. M. 1997. Rubiaceae. *In:* R. Vásquez M., Flórula de las Reservas Biológicas de Iquitos, Perú. Monogr. Syst. Bot. Missouri Bot. Gard. 63: 602–637.

——— & B. E. Hammel. 1993. Notes on *Elaeagia myriantha,* comb. nov. (Rubiaceae). Novon 3: 490–491.

Phaseolus talamancensis, a New Wild Bean Species (Leguminosae, Phaseolinae) from Montane Forests of Eastern Costa Rica

Alba Marina Torres González, Orlando Toro Chica, and Daniel G. Debouck
Genetic Resources Unit, Centro Internacional de Agricultura Tropical, Apartado Aéreo 6713, Cali, Colombia

ABSTRACT. A new species of *Phaseolus* (Leguminosae, Phaseolinae) has been found in the montane forests of the Sierra de Talamanca in eastern Costa Rica, where it appears endemic. Distinctive traits include: radicant roots, purplish red internodes, veins of leaflets, primary bracts, inner face of standard, and wings. Differences with related taxa of Costa Rica and other parts of Central America are discussed, namely the smaller and rounded primary bracts as compared to *P. macrolepis*, and the radicant fibrous root system as compared to *P. xanthotrichus*.

Key words: Costa Rica, Leguminosae, Phaseolinae, *Phaseolus*.

With a view to enrich germplasm collections for bean breeding and future genetic engineering, one of us (DGD) has collected and studied *Phaseolus* beans in Latin America since the late 1970s. During the 1987 preparation of a germplasm exploration in Costa Rica, a specimen of *G. Davidse & G. Herrera 29127* (CR) collected in 1984 from Limón appeared to be a new *Phaseolus* species for Costa Rica since it did not match with any species reported so far for that country (Debouck et al., 1989; Delgado Salinas, 1985; Piper, 1926; Standley, 1937). In the subsequent germplasm exploration, corresponding plants were found in the buffer zone of Parque Nacional Chirripó.

Phaseolus talamancensis Debouck & Torres, sp. nov. TYPE: Costa Rica. San José: San Isidro El General, 5 km N de Herradura, orillas del Río Blanco, al pie de la Fila Ojo de Agua, 83°37′W, 9°31′N, 1890 m, 13 Jan. 1987, *Debouck, Araya Villalobos, Ocampo Sánchez & González Ugalde 2130* (holotype, CR; isotypes, COL, K, MO, US). Figures 1–5.

Haec species *Phaseolo macrolepidi* similis, sed ab eo inflorescentiae bracteis primariis rotundatis vel late ovatis minoribus, ab aliis congeneris costaricensibus caulibus petiolis foliorum nervis principalibus pedunculisque purpureis vel rubrupurpureis distinguitur; cum leguminibus *Phaseolo xanthotricho* primo adspectu similibus.

Seedlings small, delicate, from hypogeal germination; epicotyl terete, green to slightly reddish, 28–32 mm long, glabrous (Fig. 1c). Primary leaves opposite, simple; lamina deltoid, acuminate, petiolate, margin puberulent with minute whitish uncinate hairs; petioles canaliculate, 4–5 mm long, green; central and two lateral main veins prominent. Stipules erect, basifixed, 1–2 mm long, oblong, slightly bifid, green; no stipels or stipels reduced to minute triangular scales, pulvini green glabrous. First true leaf trifoliolate, stipels reduced to minute triangular scales. *Roots* fibrous, often radicant with adventitious roots arising from nodes of lower stems, superficial not penetrating deep into the soil, gray brown (199A on 1966 RHS colour chart; Anonymous, 1966), with numerous nodules spheroidal, 1–3 mm, finely ridged, light to dark brown (Fig. 1a). *Plant* a short-lived herbaceous perennial with reduced branching from lower and middle stem nodes (Fig. 3a). Stem vine sprawling 1–3 m (Fig. 1b). Internodes 12 (4–17) cm, 0.7–2.5 mm diam. (up to 4.8 mm at base of main stem), terete, slightly grooved, red purplish (59A) fading green straw on drying, sparsely covered with yellow medium and short retrorse hairs, with minute uncinate hooked hairs abundant around nodes. Nodes red purplish that fade straw or light tan on drying. Stipules membranaceous, thin, basifixed, deltoid to ovate, 5–7 × 4–5 mm, reflexed or sprawling, strongly 6- to 12-nerved, red purplish (59A), sparsely puberulent, margin sparsely ciliate toward the acute to obtuse apex. *Leaves* trifoliolate, medium green (137B), slightly lustrous, sparsely puberulent with small to minute almost translucid uncinate hairs on veins, the main veins conspicuous and purplish on the upper surface, the main and secondary veins strongly conspicuous and purplish beneath with few grouped yellowish brownish long hairs, lamina finely reticulate. Petioles stout, canaliculate, 3.8–7.3 cm, purplish, sparsely puberu-

Figure 1. *Phaseolus talamancensis* Debouck & Torres. —a. Root system. —b. Habit of fertile plant. —c. Seedling. —d. Pod. —e. Seed. Floral parts (f–m):—f. Primary bract. —g. Calyx. —h. Wing. —i. Standard. —j. Vexillary stamen. —k. Keel. —l. Ovary and style. —m. Staminal tube. Scale: a–d in cm; e–m in mm. All drawings are from plants grown in Palmira and Tenerife, Colombia, of seed from the type collection (*Debouck, Araya Villalobos, Ocampo Sánchez & González Ugalde 2130*) from near Fila Ojo de Agua, orillas del Río Blanco, 5 km N de Herradura, distrito de San Isidro El General, Provincia de San José, Costa Rica.

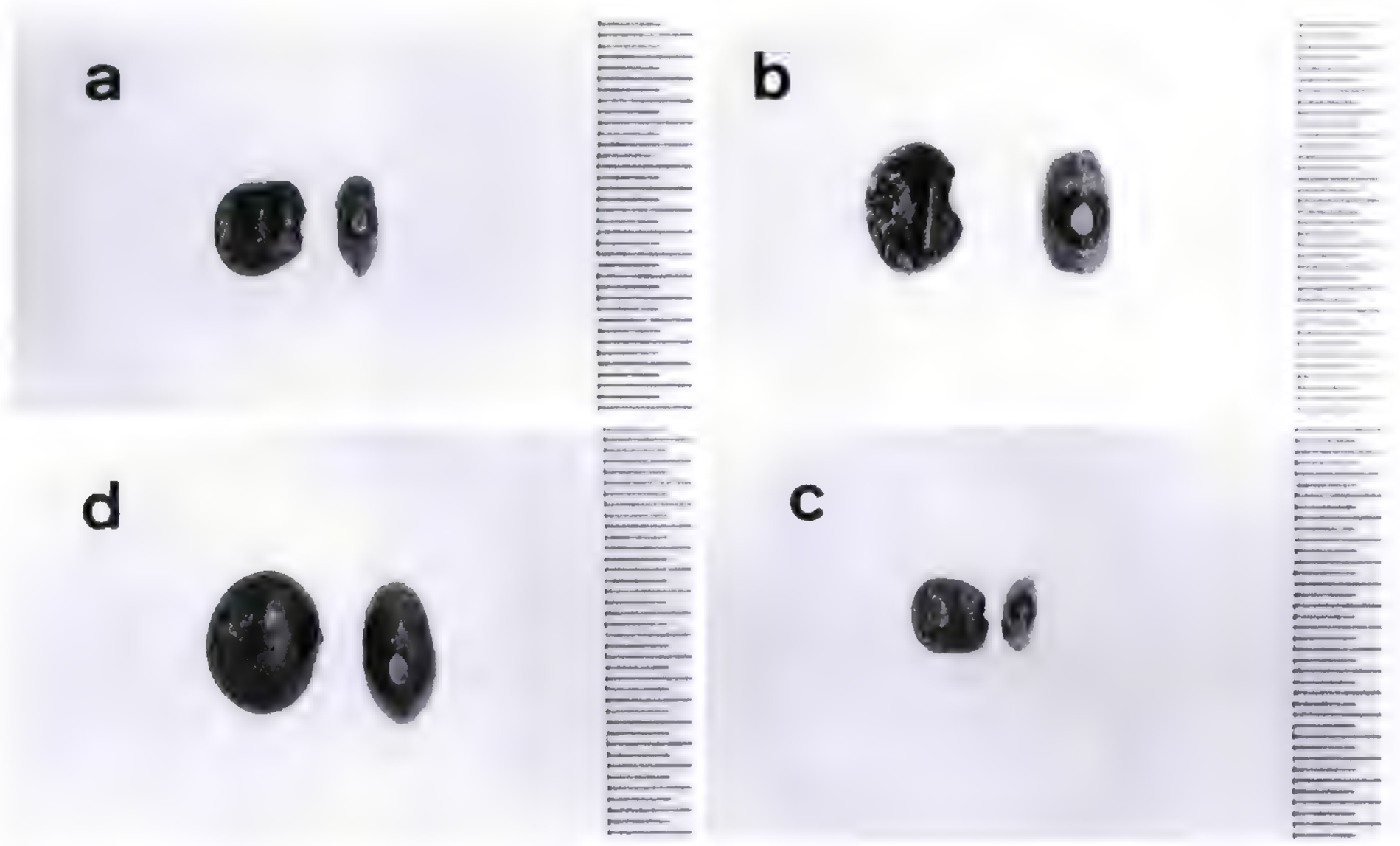


Figure 2. Close-ups of seeds in lateral views and views from hilum of: —a. *P. talamancensis* (*Debouck et al. 2130*) from type collection site. —b. *P. vulgaris* (*Debouck, Araya Villalobos & Sánchez Trejos 3131*) (wild form) from Jérico, San José, Costa Rica. —c. *P. xanthotrichus* (*Debouck, Araya Villalobos, González Ugalde, Sánchez Trejos & Camacho Chacón 3104*) from San José de la Montaña, Heredia, Costa Rica. —d. *P. macrolepis* (*Debouck & Soto 1634*) from Nahuala, Sololá, Guatemala. Same scale in mm and half mm, used for all four photographs.

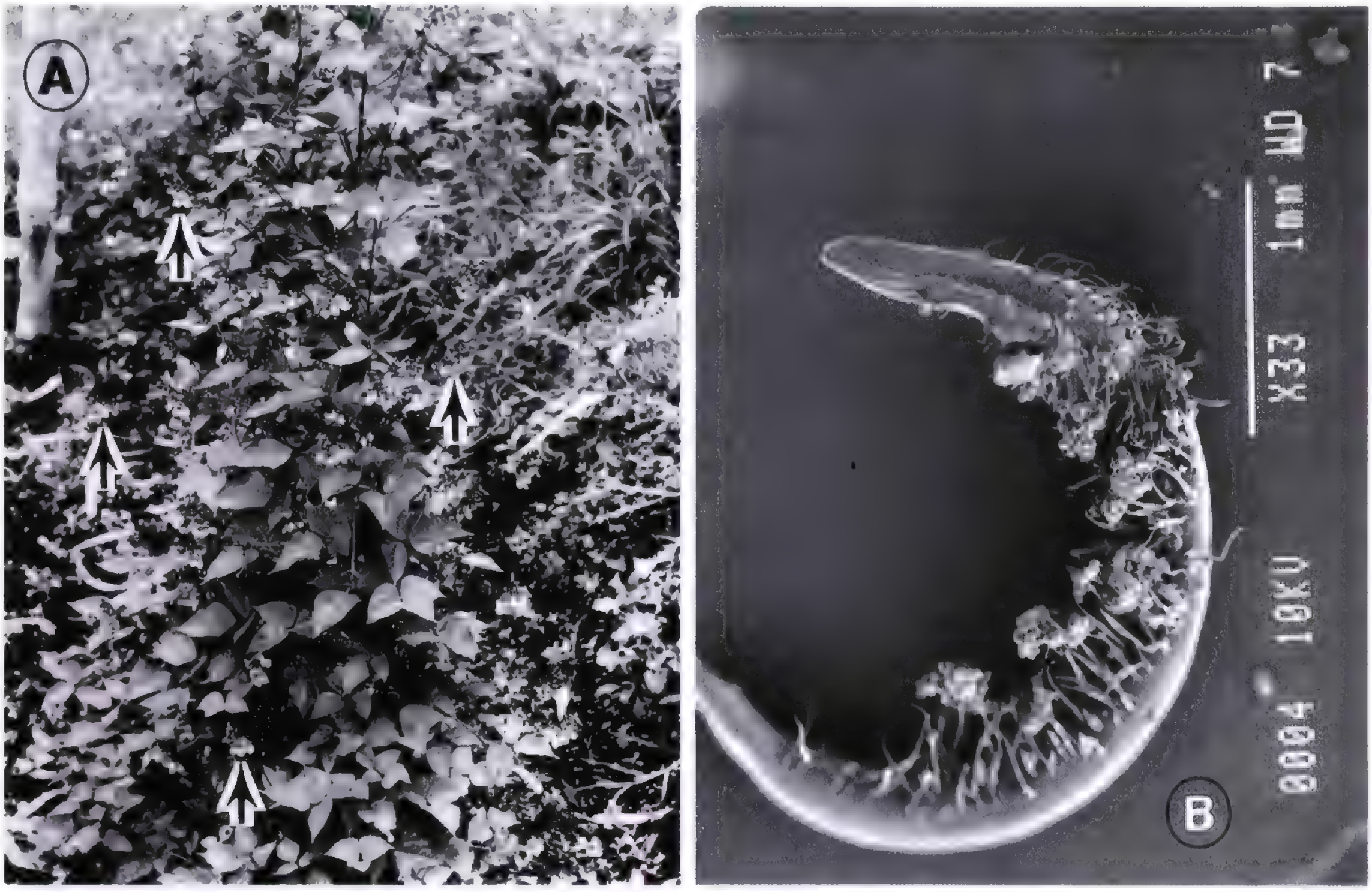


Figure 3. —a. Living plant in seed production plot in Tenerife, Valle del Cauca, Colombia; four pointing arrows indicate the location of racemes at blooming. —b. SEM micrograph of the distal portion of style and stigma. Scale bar: 1 mm.

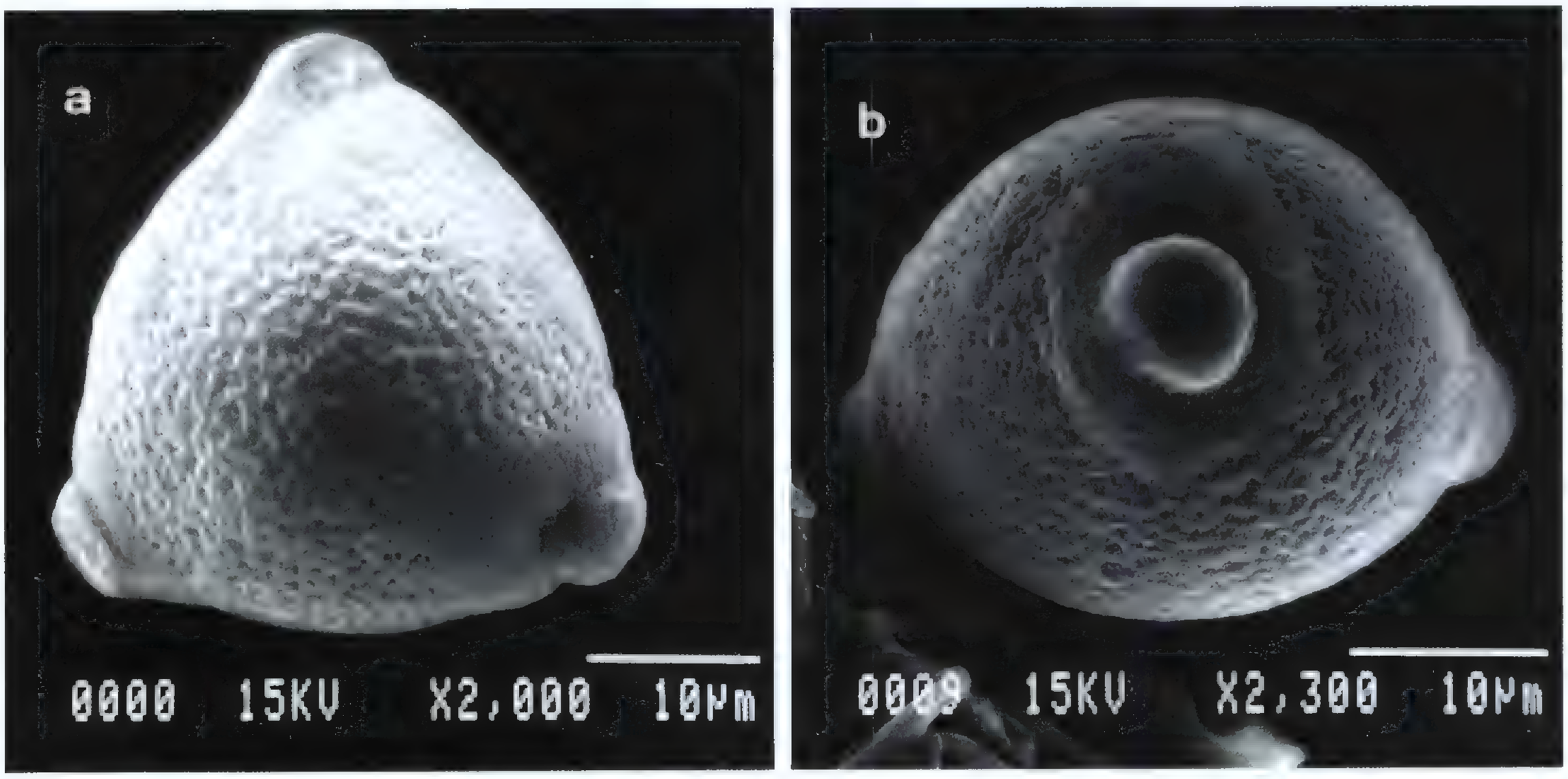


Figure 4. Micrographs of pollen grains. Polar (a) and equatorial (b) views; in the latter a colporus is clearly visible in the center, surrounded by mesh walls. Scale bar: 10 microns.

lent; basal pulvinus 6–7 mm, hairy, green turning yellowish green on drying; distal pulvinus 3–4 mm, hispid above. Rachis canaliculate, 9–11 mm, purplish, glabrescent. Lateral stipels lanceolate, acute, 2- or 3-nerved, 2–3 × 1 mm, glabrescent, margin sparsely ciliate. Distal stipels 1-nerved, 1 × 0.8–0.9 mm, margin puberulent. Lateral leaflets with pulvini 2–4 mm, green, ventrally tawny-hispid. Terminal leaflet deltoid to ovate, acuminate, occasionally curvilinearily caudate, 7.5 (4–8.9) × 5 (2.8–6.3) cm. Lateral leaflet inequilateral, ovate acuminate to curvilinearily caudate, 6.5 (3.3–7.7) × 4.4 (2.3–5.2) cm, main vein dividing lamina 1/3 distally and 2/3 proximally. *Inflorescence* a raceme of racemes, 26.5 (14.8–34) cm long, ascending, twice exceeding the leaves. Peduncle 14.8 (5.9–17.5) cm, terete, purplish green turning yellowish green upon drying, glabrous. Rachis stout, with 14 to 24 flowering secondary racemes; secondary racemes proximally 2.7 (3.1–1.4) cm distally 0.5 (0.8–0.2) cm spaced, purplish green turning yellowish green upon drying, sparsely puberulent with small whitish uncinate hairs. Secondary racemes extremely reduced. Primary bracts rounded to broadly ovate, 8–10 × 6–7 mm, with a short acumen seldom 2- or 3-toothed, ciliate, 6- to 9-nerved, purplish red (59A) fading purplish tan upon drying, persistent until anthesis, often caducous once pods fully develop (Fig. 1f). Pedicellar bracts triangular, hyaline, 0-nerved, 1 mm long or less, early caducous. Pedicels terete, 9 (7–11) mm long, ascending, purplish red fading yellow or tan, with sparsely minute uncinate hairs. Bracteoles lanceolate, hyaline, 0- to 1-nerved, 1 mm long or less, caducous shortly after anthesis. *Flowers* purplish red fading purplish violet, 2 for each secondary raceme. Calyx campanulate, 5 (4–6) mm long, lobes subequal, the upper lobes wider than the lower ones, triangular, short, margin shortly ciliolate, glabrous with minute whitish uncinate hairs, purplish (Fig. 1g). Standard purplish red (74A) fading purple (77A), outer face shiny purple violet (83A), 12 × 12 mm, with claw forward and limb erect above a deep sinus, rounded, emarginate, glabrous, auricles reflexed (the right auricle more reflexed than the left one), thickened at flexure; claw 2 mm long, channel-shaped, with two subequal longitudinal triangular callosities (Fig. 1i). Wings purplish red (74A) fading purple (77A), spreading obliquely forward, subequal, rounded, cupped, 17–19 mm long, blade 14 × 10 mm, channel-shaped above the claw, claw 5 × 1 mm, spur squarish, adherent to the keel (Fig. 1h). Keel tubular, spirally incurved, ca. 10 mm long, 1¼ coil, claws divided 3–4 mm long, 2 mm to flexure and 3.7–4.6 mm from flexure to terminal coil, convex "pockets" 2 mm long at the flexure adhering to the wings, glabrous, whitish at base (Fig. 1k). Stamens diadelphous (9 + 1). Vexillary stamen free, ca. 8.7 mm long, curved claw 1 mm long to cupulate knob 0.8 mm long, 1.3 mm wide (Fig. 1j). Staminal tube 10 mm long, smoothly veined, circular opening for the vexillary stamen with small appendages when closing (Fig. 1m). Anthers ellipsoid, dorsifixed, dithecal, yellow. *Pollen* spheroidal, tricolporate, and finely reticulate; both axes subequal, diameter 30–32 µm,

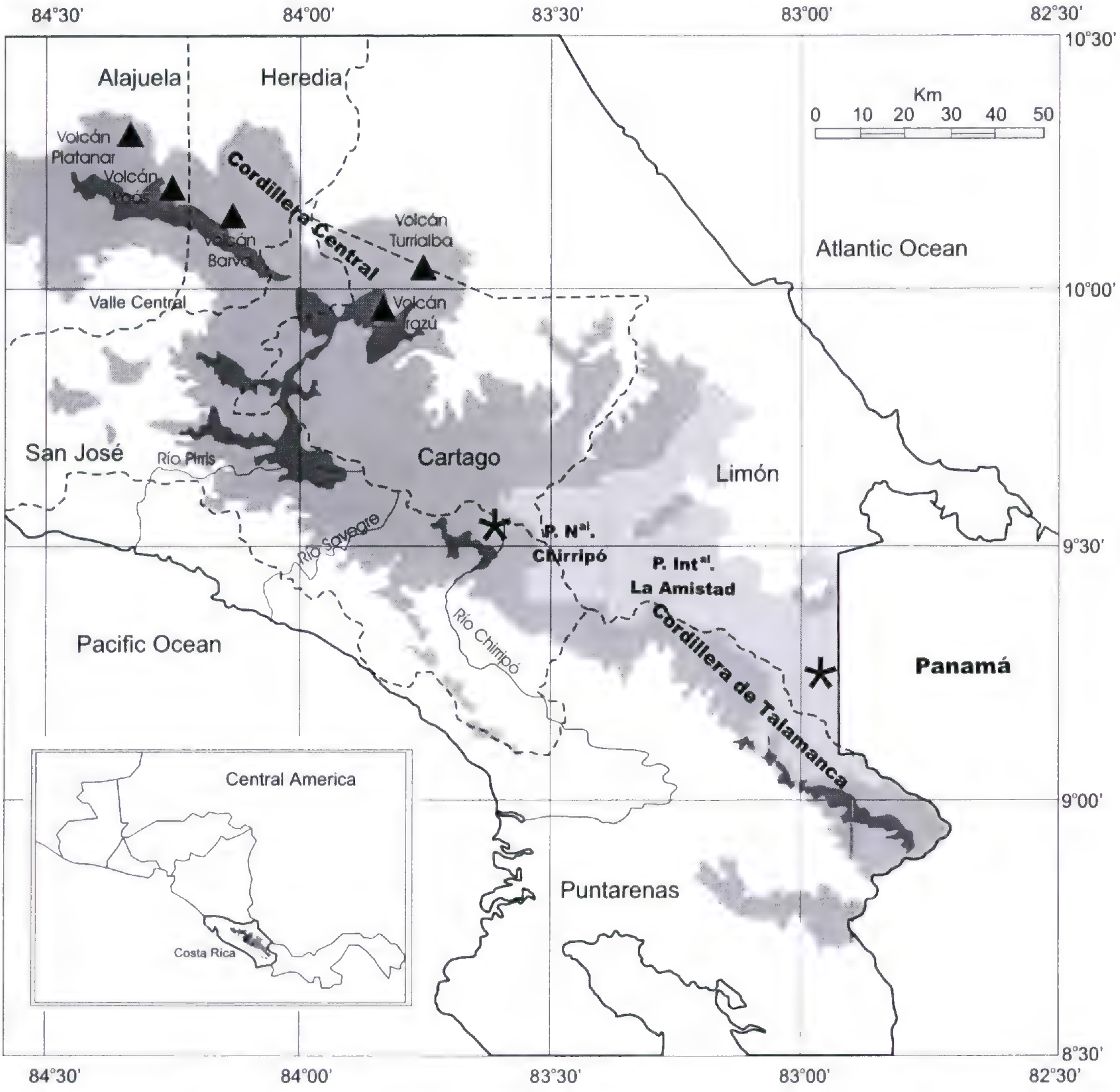


Figure 5. Distribution map for *P. talamancensis* in eastern Costa Rica. Stars mark where the two populations of *P. talamancensis* have been found so far. Solid triangles correspond to volcanoes. Dotted lines indicate limits of provinces. Light-shaded areas refer to protected areas "Parque Nacional Chirripó" and "Parque Internacional La Amistad." Medium-shaded areas refer to landmasses above 1000 m a.s.l.; dark-shaded areas refer to the life zone Lower Montane Wet Forest (after Tosi, 1969).

margin bordering the colpi well developed 3–4 μm wide, endoaperture circular diameter 7–8 μm; endoaperture membrane smooth, ectoaperture membrane finely granular, tectum finely corrugated (Fig. 4a, b). Gynoecium with a basal disk diameter 1 mm, 0.5 mm high, denticulate. Ovary ca. 5 mm long, straight, laterally compressed, finely velvety with minute uncinate hairs, 6 or 7 ovules (Fig. 1l). Style upturned and spiraled, ca. 10 mm long with long fine hairs below the stigma, not pronounced beyond the stigma. Stigma triangular, adaxially oriented, orange yellow (Fig. 3b). *Pod* straight, slightly falcate, 43–67 × 4–9 mm, chartaceous, obliquely finely veined, sutures pronounced, 4 to 7 seeds, strongly dehiscent, beak small, delicately recurved, sparsely puberulent with few uncinate hairs, purplish green when young, green once fully developed drying tan brown (165A) (Fig. 1d). *Seed* suborbicular convex, 3–5 × 3–4 mm, black speckled on tan brown background, hilum elliptic white, a black ring around the hilum, lens slightly raised (Fig. 1e, 2a).

The above description has been made on holotype and isotype vouchers obtained from and on living plants grown at CIAT, in the substations of Palmira, Popayán, and Tenerife, Colombia, which allow the description of all parts, including seed-

lings. Color codes mentioned in the description refer to the RHS chart (Anonymous, 1966). Small amounts of seed are available from the Genetic Resources Unit of CIAT.

Geographic distribution. This species seems to be distributed only in the eastern part of Costa Rica, on both slopes of Sierra de Talamanca (Fig. 5). While the material *G. Davidse & G. Herrera 29127* (CR) was found on the Atlantic slope of the Cordillera de Talamanca in the southeastern corner of the Limón province, the type population of *Debouck et al. 2130* was found on its Pacific slope in the eastern part of San José province. It is premature to conclude about its rarity or level of endemism, given the incomplete botanical survey of eastern Costa Rica. Only two specimens have been found so far in herbaria. A possible explanation for this may lie in the fractionating and small acreage of the habitats in which *P. talamancensis* has been found so far (see below). On the other hand, part of its range could be in the Parque Internacional La Amistad, an important protected area between Costa Rica and Panama (Herlihy, 1997; Robison et al., 1993).

Ecology. This species is found in humid montane forests at elevations around 1800–1900 m. These habitats correspond to mixed forests described by Gómez Pignataro (1986) or the lower montane wet forest reported by Bolaños and Watson (1993), Hartshorn (1983), Sawyer and Lyndsey (1971), and Tosi (1969). They occupy only a small acreage in Costa Rica (767 km² or 1.5% of land: Hartshorn, 1983). There the short dry season would be from December to March (Herrera, 1985). As compared to other *Phaseolus* species thriving in Costa Rica, e.g., *P. lunatus* L., *P. oligospermus* Piper, *P. tuerckheimii* Donnell-Smith, and *P. vulgaris* L. (Araya Villalobos et al., 2001), *P. talamancensis* seems to be an early plant blooming around October and setting seeds in December. As searches for common bean germplasm are often carried late in the year in Central America, early species such as this one may have escaped the attention of plant collectors. Developing seeds of the type collection were heavily infested by bean pod weevils (Coleoptera, Curculionidae, *Apion* sp.). The presence of spider mites was noted at the type locality. While under cultivation in the field in Colombia, *P. talamancensis* was found susceptible to nematode attacks.

Etymology. The species is named in honor of the Talamanca Amerindians who first inhabited the mountainous range that is today called Sierra de Talamanca, where the species is distributed (Fig. 5).

Discussion. The intense purplish red color of the corolla is a distinctive trait of this new species. The large ovate red purple sometimes caducous primary bracts are also noteworthy. It is generally accepted (Lackey, 1983; Maréchal et al., 1978) that primary bracts are persistent up to anthesis in *Phaseolus*, in contrast with *Vigna* and *Macroptilium* species. As compared to other *Phaseolus* species present in Costa Rica, e.g., *P. lunatus*, *P. oligospermus*, *P. tuerckheimii*, and *P. vulgaris* (Debouck et al., 1989), floral bracts (primary and pedicellar bracts, and bracteoles) usually fall early in the course of floral ontogenesis and pod development in *P. talamancensis*. Pods and seeds (Figs. 1 and 2a–c, respectively) are similar to those of *P. xanthotrichus* Piper, although larger. In contrast with *P. xanthotrichus*, *P. talamancensis* has the distal part of the keel 1-¼ coiled, with the terminal part of the coil coming from the right, vertically located in the front, and counterclockwise. It thus belongs to the section *Phaseolus* of the genus as currently understood (Delgado Salinas, 1985; Maréchal et al., 1978). The pollen (Fig. 4) is tricolporate with a finely reticulate exine: both traits are relatively common in *Phaseolus* (Delgado Salinas, 1985). Another distinctive trait of *P. talamancensis* is the radicant and fibrous non-tuberous root system associated with hypogeal germination. This contrasts with the very frequent association of tuberous (conical, cylindrical, spherical) root systems with hypogeal germination in section *Phaseolus* (Caicedo et al., 1999). Lateral leaflets are often inverted once the plant is put in the plant press because of a peculiar phototropism on living plants (Fig. 3a).

The type collection has been elsewhere (Delgado et al., 1999) considered as *P. macrolepis* Piper, from which it clearly separates by several traits. In *P. macrolepis* inflorescence primary bracts are longer (10–25 mm long), foliaceous, and "elliptical, long-acuminate" (Piper, 1926: 698). Its leaflets are narrower and "long-acuminate and apiculate" (Piper, 1926: 698). Pods are broader (10–12 mm wide) and flattened in *P. macrolepis* as compared to *P. talamancensis*. Seeds are larger and roundish in *P. macrolepis* as compared to *P. talamancensis* (Fig. 2d and 2a, respectively). So far, *P. macrolepis* has not been found outside central and western Guatemala, where it seems to be endemic (Debouck, 1991, 1999; Delgado Salinas, 1985). According to Delgado Salinas and co-workers (1999), on the basis of ITS/5.8S DNA sequence, the material *Debouck et al. 2130* would be remotely related to *P. oligospermus*, *P. tuerckheimii*, and *P. xanthotrichus*.

Paratype. COSTA RICA. **Limón:** Cordillera de Tal-

amanca, Atlantic slope, canyon of the Río Sini, elevation 1800–1900 m, 9°13′N, 82°59′W, "climbing vine, petals reddish-violet," 15 Nov. 1984, *G. Davidse & G. Herrera 29127* (CR, MO 5192727).

Acknowledgments. The senior author expresses gratitude to Rodolfo Araya Villalobos, Rafael Ocampo Sánchez, and William González Ugalde for enthusiastic and continuing support during fieldwork in 1987. The help of G. Davidse (MO) and W. Burger (F) in locating the paratype has been much appreciated. The financial support of the International Board for Plant Genetic Resources for the fieldwork is deeply acknowledged. The help of José Alejandro Arroyave and the Virology Unit of CIAT for the SEM micrographs of pollen and stigma has been most appreciated. The help of Oscar Idárraga and Fernando Pino, both at the Graphic Arts Unit of CIAT, for the preparation of the map and the photographs of seeds, respectively, is acknowledged. The authors thank the curators of CR, F, K, MO, US, and USJ for the loan of specimens.

Literature Cited

Anonymous. 1966. Royal Horticultural Society Colour Chart. The Royal Horticulural Society, London, United Kingdom, Fans 2 and 4.

Araya Villalobos, R., W. G. González Ugalde, F. Camacho Chacón, P. Sánchez Trejos & D. G. Debouck. 2001. Observations on the geographic distribution, ecology, and conservation status of several *Phaseolus* bean species in Costa Rica. Genet. Resources & Crop Evol. 47: in press.

Bolaños M., R. A. & V. Watson C. 1993. Mapa ecológico de Costa Rica. Centro Científico Tropical. Scale 1: 200.000, 9 sheets, San José, Costa Rica.

Caicedo, A. L., E. Gaitán, M. C. Duque, O. Toro Ch., D. G. Debouck & J. Tohme. 1999. AFLP fingerprinting of *Phaseolus lunatus* L. and related wild species from South America. Crop Sci. 39: 1497–1507.

Debouck, D. G. 1991. Systematics and morphology. Pp. 55–118. *in* A.v. Schoonhoven & O. Voysest (editors), Common Beans—Research for Crop Improvement. Commonwealth Agricultural Bureaux International, Wallingford, U.K.

———. 1999. Diversity in *Phaseolus* species in relation to the common bean. Pp. 25–52 *in* S. P. Singh (editor), Common Bean Improvement in the Twenty-first Century. Kluwer Academic Publishers, Dordrecht, Holland.

———. 2000. Biodiversity, ecology, and genetic resources of *Phaseolus* beans—Seven answered and unanswered questions. Pp. 95–123 *in* K. Oono (editor), Wild Legumes. National Institute of Agrobiological Resources, Tsukuba, Japan.

———, R. Araya Villalobos, R. A. Ocampo Sánchez & W. G. González Ugalde. 1989. Collecting *Phaseolus* in Costa Rica. FAO/IBPGR Plant Genet. Resources Newsl. 78/79: 44–46.

Delgado Salinas, A. 1985. Systematics of the Genus *Phaseolus* (Leguminosae) in North and Central America. Ph.D Thesis, University of Texas, Austin, Texas.

———, T. Turley, A. Richman & M. Lavin. 1999. Phylogenetic analysis of the cultivated and wild species of *Phaseolus* (Fabaceae). Syst. Bot. 24: 438–460.

Gómez Pignataro, L. D. 1986. Vegetación de Costa Rica. Editorial Universidad Estatal a Distancia, San José, Costa Rica.

Hartshorn, G. S. 1983. Plants—Introduction. Pp. 118–157 *in* D. H. Janzen (editor), Costa Rican Natural History. Univ. Chicago Press, Chicago, Illinois.

Herlihy, P. H. 1997. Central American Indians peoples and lands today. Pp. 215–240 *in* A. G. Coates (editor), Central America—A Natural and Cultural History. Yale Univ. Press, New Haven, Connecticut.

Herrera, W. 1985. Clima de Costa Rica. Editorial Universidad Estatal a Distancia, San José, Costa Rica.

Lackey, J. A. 1983. A review of generic concepts in American Phaseolinae (Fabaceae, Faboideae). Iselya 2: 21–64.

Maréchal, R., J.-M. Mascherpa & F. Stainier. 1978. Étude taxonomique d'un groupe complexe d'espèces des genres *Phaseolus* et *Vigna* (Papilionaceae) sur la base de données morphologiques et polliniques, traitées par l'analyse informatique. Boissiera 28: 1–273.

Piper, C. V. 1926. Studies in American Phaseolinae. Contr. U.S. Natl. Herb. 22: 663–701.

Robison, D. M., E. Barona, S. E. Castaño, M. Rincón, H. Becerra, M. R. Henao & L. García. 1993. Areas legalmente protegidas y su relación con la frontera agrícola en el trópico americano. Centro Internacional de Agricultura Tropical, Cali, Colombia.

Sawyer, J. O. & A. A. Lindsey. 1971. Vegetation of the life zones in Costa Rica. Indiana Acad. Sci. Monogr. 2: 1–214.

Standley, P. C. 1937. Flora of Costa Rica. Field Mus. Nat. Hist. Bot. Ser. 18: 1–1616.

Tosi, J. A. 1969. Mapa ecológico, República de Costa Rica, según la clasificación de zonas de vida del mundo de L. R. Holdridge. Centro Científico Tropical, San José, Costa Rica, 1 sheet.

Billia rosea: The Correct Name for *Billia columbiana* (Hippocastanaceae)

Carmen Ulloa Ulloa and Peter M. Jørgensen
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

Abstract. In order to comply with the current *International Code of Botanical Nomenclature* a new combination, *Billia rosea* (Planchon & Linden) C. Ulloa & P. Jørgensen, is proposed to replace the superfluous name *Billia columbiana* Planchon & Linden ex Triana & Planchon.

Resumen. Para conformar con el Código Internacional de Nomenclatura Botánica vigente se propone la nueva combinación *Billia rosea* (Planchon & Linden) C. Ulloa & P. Jørgensen que reemplaza a *Billia columbiana* Planchon & Linden ex Triana & Planchon, un nombre superfluo.

Key words: *Billia*, Hippocastanaceae, Neotropics.

The name *Billia columbiana* Planchon & Linden ex Triana & Planchon has been used for a Neotropical buckeye for almost 140 years. The name is, however, inconsistent with the current *Code* of nomenclature (ICBN, Greuter et al., 2000), a situation we here correct. Planchon and Linden (1857) published the genus *Putzeysia* with a single species, *P. rosea*, in the Hippocastanaceae. By doing so they created a later generic homonym [not *Putzeysia* Klotzsch (1855) in the Begoniaceae]. Under Article 42.1 of the ICBN, however, *P. rosea* was validly published. This 1857 publication, a sale catalogue of introduced plants from Linden's greenhouse, did not provide a generic description, and the French description of the species did not cite any specimens. In 1862 Triana and Planchon transferred *Putzeysia rosea* to the genus *Billia* Peyritsch. However, they used a new name, *Billia columbiana*, ascribed to Planchon and Linden, and cited *Putzeysia rosea* as a synonym; this created a superfluous name (see ICBN Articles 52.1 and 55.1). Along with the Latin description of *Billia columbiana* they listed three collections from Colombia (including one of Triana) and indicated that it occurs in Venezuela. In his revision of the American Hippocastanaceae, Hardin (1957) maintained the name *Billia columbiana* and designated the Triana collection deposited in the Herbario Nacional Colombiano (COL) as the type and mentioned a fragment at US.

As a consequence of the publication of the superfluous name we propose the following new combination for this Neotropical buckeye, which grows in Costa Rica, Panama, Venezuela, Colombia, and Ecuador.

Billia rosea (Planchon & Linden) C. Ulloa & P. Jørgensen, comb. nov. Basionym: *Putzeysia rosea* Planchon & Linden, in Linden's Cat. Pl. Exot. 12: 3. 1857. TYPE: Colombia. Dept. Caldas: Pácora, Aguadas, 2000 m, Mar. 1852, *J. Triana s.n.* (lectotype, designated by Hardin (1957), COL-07181 not seen, photocopy at MO; isolectotypes, G not seen, F neg. no. 23268, US [fragment], scanned image seen).

Billia columbiana Planchon & Linden ex Triana & Planchon, nom. illeg., Ann. Sci. Nat. Bot. ser. IV 18: 367. 1862.

Acknowledgments. We thank A. Pool for calling our attention to this nomenclatural problem, D. Neill and J. Hardin for their review comments, and J. Betancur (COL), T. Hollowell (US), and C. Niezgoda (F) for kindly providing information on the type material.

Literature Cited

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (St. Louis Code). Regnum Veg. 138.

Hardin, J. W. 1957. A revision of the American Hippocastanaceae—II. Brittonia 9: 173–195.

Klotzsch, J. F. 1855. Begoniaceen-Gattungen und Arten. Abh. Königl. Akad. Wiss. Berlin 1854: 1–135.

Planchon, J. E. & J. Linden. 1857. *Putzeysia rosea*, Pl. et Lind. *In* J. Linden, Cat. Pl. Exot. 12: 3.

Triana, J. & J. E. Planchon. 1862. Prodromus Florae Novo-Granatensis. Ann. Sci. Nat. Bot. ser. IV 18: 258–381.

Volume 11, Number 2, pp. 157–288 of NOVON was published on 10 July 2001.

Volume 11
Number 3
2001

NOVON

Cardamine gouldii (Brassicaceae), a New Species from Bhutan

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.

ABSTRACT. The new species *Cardamine gouldii* is described and illustrated from Bhutan. Its distinguishing characters and relationship to the closely related Himalayan *C. violacea* and *C. nepalensis* are discussed. This last species is reported for the first time from Sikkim.

Key words: Bhutan, *Cardamine*, Sikkim.

During my visit in 1998 to the Royal Botanic Gardens, Kew, a few collections of undescribed taxa of Brassicaceae were pulled out for loan and further study. One of these was recently described in the new genus *Baimashania* (Al-Shehbaz, 2000), and a second is described herein as *Cardamine gouldii*.

Cardamine gouldii Al-Shehbaz, sp. nov. TYPE: Bhutan. [Bumthang District], Yatong La to Gyesta, 9800–11700 ft., 7 May 1938, *B. J. Gould 415* (holotype, K). Figure 1.

Herba perennis, caulibus striatis, pilosis. Folia caulina superiora 3–5-foliolata, petiolibus 1–3 cm longis, nonauriculatis; foliola terminalia oblonga vel oblongo-lanceolata, 2.5–5 × 0.7–2 cm, sparse hirsuta, integra, ciliolata, mucronulata; foliola lateralia oblonga, sessilia. Racemi 5–10-flori. Pedicelli floriferi recurvati, 5–10 mm longi. Sepala oblonga, 5–7 × 2–3 mm, sparse pilosa, saccata. Petala alba, oblonga, 12–15 × 4–6 mm. Filamenta mediana 8–10 mm longa, filamenta lateralia 6–7 mm longa; anthera oblonga, ca. 1.5 mm longa. Fructus et semina ignota.

Perennial herbs. Underground parts, basal leaves, and lowermost portions of stem unknown. Stems striate, sparsely pilose with trichomes to 0.6 mm long; distal nodes 5–11 cm apart. Middle leaves 5-foliolate; uppermost trifoliolate; petiole 1–3 cm long, narrowly winged, base not auriculate; terminal leaflet oblong to oblong-lanceolate, 2.5–5 × 0.7–2 cm, sparsely hirsute with trichomes to 0.6 mm long, subsessile or cuneate basally into a petiolule to 5 mm long, margin entire to repand, ciliolate with trichomes to 0.1 mm long, lateral veins ending in mucronulate callosities to 0.2 mm long, apex rounded to obtuse; lateral leaflets oblong, sessile, similar to and smaller than terminal leaflet. Racemes lax, 5- to 10-flowered. Flowering pedicels slender, recurved, 5–10 mm long. Sepals drying lavender, oblong, 5–7 × 2–3 mm, sparsely pilose, base saccate. Petals white, oblong, 12–15 × 4–6 mm, apex rounded; claw ca. 1.5 mm long. Stamens erect; filaments of median pairs 8–10 mm long, those of lateral pair 6–7 mm; anthers oblong, ca. 1.5 mm long. Fruit and seeds unknown.

Cardamine gouldii, which is known thus far only from the type collection and is named after the collector of the holotype, B. J. Gould, is most closely related to *C. violacea* (D. Don) Wallich ex J. D. Hooker & Thomson (Bhutan, Nepal, Sikkim) and *C. nepalensis* Kurosaki & H. Ohba. The last species was known previously from three Nepalese collections (Kurosaki & Ohba, 1989) and is reported herein for the first time from Sikkim. This record is based on *Cooper 348* (E). All three species are robust plants with pendulous flowers, petals more than 1 cm long, and saccate sepals.

Cardamine gouldii is easily distinguished by having white, oblong petals, non-auriculate petioles, and 3- to 5-foliolate compound leaves with entire to repand leaflets rounded to obtuse at apex. By contrast, *C. violacea* has purple, obovate to spatulate petals and sessile, simple leaves with a strongly sagittate base, dentate to denticulate margin, and acuminate to caudate apex. *Cardamine nepalensis* has purple, obovate petals, mi-

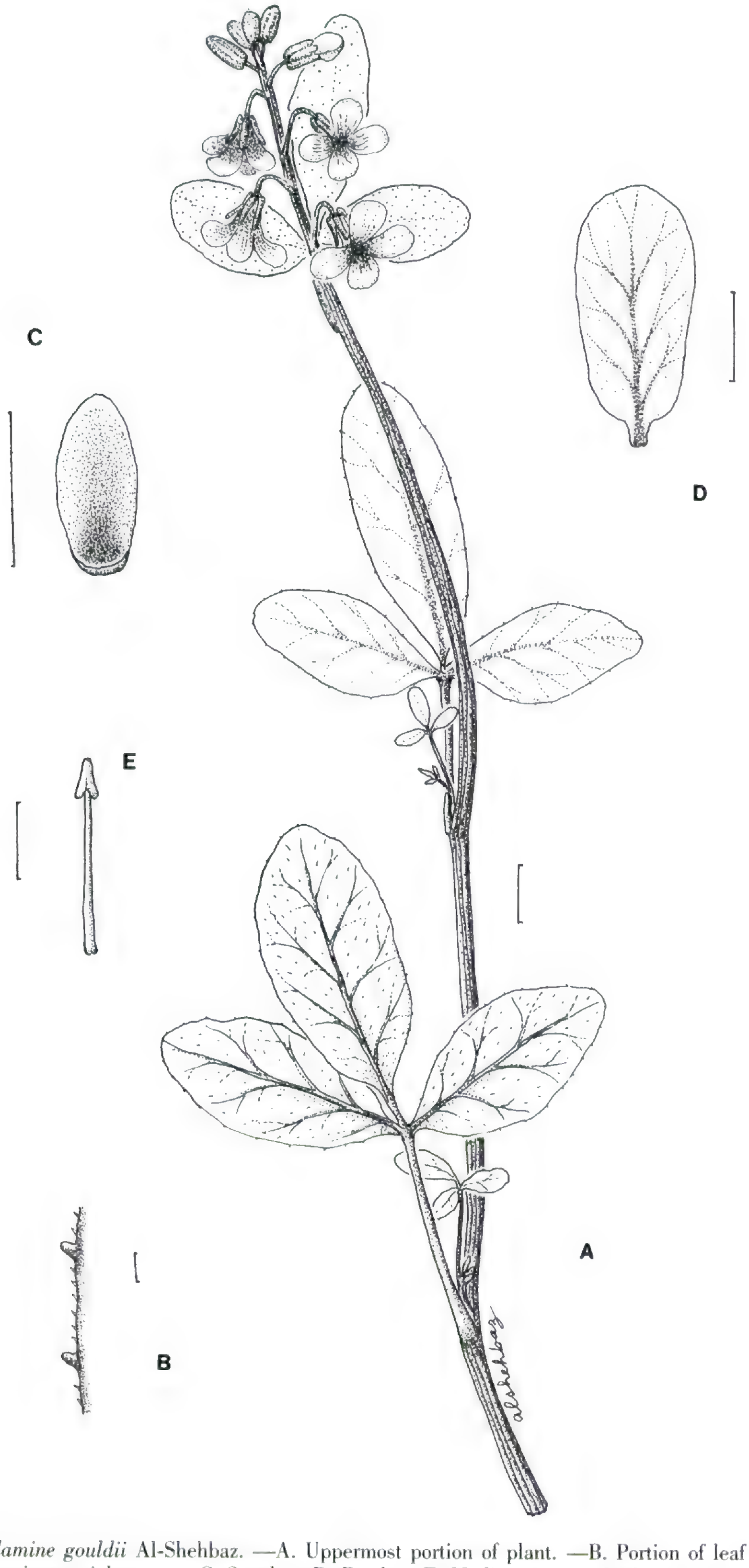


Figure 1. *Cardamine gouldii* Al-Shehbaz. —A. Uppermost portion of plant. —B. Portion of leaf margin showing two callosities and minute trichomes. —C. Sepal. —D. Petal. —E. Median stamen. Scale: A = 1 cm; B = 0.2 mm; C–E = 5 mm. Drawn by Al-Shehbaz from the holotype (*Gould 415*).

nutely auriculate petioles, and pinnatisect leaves with dentate to denticulate margin and acuminate terminal lobe and decurrent lateral lobes. The uppermost leaves in *C. nepalensis* are sometimes simple.

Although the lowermost portions of the plant are missing in the three segments of the holotype of *Cardamine gouldii*, the species is described herein as perennial and is inferred as similar to the native, large-flowered (petals 10–17 mm) Himalayan species of *Cardamine*. All of the annual species of *Cardamine* known to grow in the Himalayas are naturalized, small-flowered weeds with petals rarely up to 5 mm long.

Acknowledgments. I am most grateful to Sue Zmarzty and Gillian Challen for their help during my visit to K in 1998 and to Mark Watson (E) for advice about the type locality.

Literature Cited

Al-Shehbaz, I. A. 2000. *Baimashania* (Brassicaceae), a new genus from China. Novon 10: 320–322.

Kurosaki, N. & H. Ohba. 1989. *Cardamine nepalensis*, a new species from Nepal Himalaya (Cruciferae). J. Jap. Bot. 64: 135–138.

The Chilean *Agallis* and Californian *Tropidocarpum* (Brassicaceae) are Congeneric

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.

Robert A. Price
P.O. Box 8082, Athens, Georgia 30603, U.S.A.

ABSTRACT. *Agallis* is reduced to synonymy of *Tropidocarpum*, and the new combination *T. lanatum* is therefore proposed. The morphological similarities in plant aspect, flowers, and fruit between the two genera are presented, and a key to species of *Tropidocarpum* is given. Disjunction between North and South American congeners of the Brassicaceae is discussed.

Key words: *Agallis*, North-South American disjunctions, *Tropidocarpum*.

The recent discovery of the monotypic *Twisselmannia* (Al-Shehbaz, 1999) prompted comparative and molecular studies on the Californian *Tropidocarpum* Hooker (2 spp.) and Chilean *Agallis* Philippi (monotypic). The results of that study will be published elsewhere.

The monotypic *Twisselmannia* was previously known from two collections from Kings County, California, *LaRue s.n.* (UCR) and *Taylor & Ertter 17098* (MO, UC), but a third collection, *Twisselmann 10447* (CDA), was collected from Kern County on a canal bank at the southern end of Kern National Wildlife Refuge.

Agallis lanata (Barnéoud) Gilg & Muschler ex O. E. Schulz is restricted to central Chile and is known from several old collections (see below), while *Tropidocarpum gracile* Hooker is widespread in northern Baja California and southern California northward through the central valley north of San Francisco (Rollins, 1993a; Wiggins, 1980). By contrast, *T. capparideum* E. L. Greene, which is presumed extinct (Rollins, 1993a), is known from older collections made near Mount Diablo at the northwestern part of San Joaquin Valley.

The similarities between *Agallis*, *Tropidocarpum*, and *Twisselmannia* include annual habit, indumentum of coarse simple trichomes mixed with smaller forked ones, pinnatisect to pinnatifid petiolate leaves, racemes bracteate throughout, yellow flowers occasionally tinged with purple, dilated bases of staminal filaments, angustiseptate fruits, mucilaginous seeds, and incumbent cotyledons. *Twisselmannia* is easily separated from the other two by having obdeltoid, 4- to 8-seeded silicles and antrorsely hirsute fruit valves that are tuberculate-rugose, thick leathery to subwoody on the distal halves, and abruptly narrowed to apex. In contrast, *Agallis* and *Tropidocarpum* have linear or oblong to elliptic, 16- to 70-seeded siliques and uniformly leathery, retrorsely hirsute (except when glabrescent) valves with obtuse apices. Except for the valve number, which is two in *Agallis lanata* and four in *T. capparideum*, the other differences separating the two species are quantitative. The increase in valve number is a highly unusual feature in the Brassicaceae, and within *Tropidocarpum* the fruits of *T. gracile* are 2-valved whereas those of *T. capparideum* are 4-valved. The only other documented example is in the unrelated genus *Rorippa* Scopoli (ca. 75 spp.), in which one species, *R. barbareifolia* (DC.) Kitagawa, has 4- to 6-valved fruits. On the basis of these remarkable morphological similarities between *Agallis* and *Tropidocarpum*, the two genera are herein united.

Tropidocarpum becomes the fifth genus of Brassicaceae with known disjunct distribution in temperate North and South America. *Mancoa* Weddell is represented by seven species in northern Mexico and adjacent Texas and four species in southern Peru, Bolivia, and northern Argentina (Rollins, 1941; Al-Shehbaz, 1990). *Pennellia* Nieuwland includes 11 species, of which eight are distributed from northern Guatemala into Mexico and the southwestern United States (Rollins, 1980, 1993a), one in southern Bolivia and northern Argentina (Al-Shehbaz, 1990), and two were treated by Rollins (1993b) in *Arabis* but now belong to *Pennellia* (Bailey, 2001; Price et al., in press). Other South American species listed by Schulz (1924, 1936) under *Heterothrix* Rydberg or *Pennellia* belong to the poorly defined *Sisymbrium* L. sensu lato (Al-Shehbaz, 1990).

The fourth genus with disjunct distribution is

Lesquerella S. Watson (ca. 100 spp.), which is distributed primarily in the southern and western United States and northern Mexico. One species, *L. arctica* (Wormskiöld & Hornemann) S. Watson, grows in Greenland, Alaska, and the Canadian and Russian arctic and subarctic regions (Rollins & Shaw, 1973; Jurtzev, 1975), while a few species of the *L. mendocina* (Philippi) Kurtz complex are disjunctly restricted to Argentina from Mendoza south into Chubut (Boelcke & Romanczuk, 1984). Finally, *Thlaspi* L. is represented in South America by one native species, the Patagonian *T. magellanicum* Commerson ex Poiret (Boelcke & Romanczuk, 1984), which is quite disjunct from the four to six native North American species that are distributed from northern Mexico and western United States northward into Alaska (Holmgren, 1971; Rollins, 1993a). Detailed aspects for other North and South American disjunctions also present in other plant families are discussed in the classic work of Raven (1963).

Although *Cardamine* L., *Descurainia* Webb & Berthelot, *Draba* L., *Halimolobos* Tausch, *Lepidium* L., and *Rorippa* are represented by indigenous species in both North and South America, their distributions are basically continuous. However, molecular studies on *Draba* show that some of the South American species are most closely related to disjunct relatives in North America (Koch & Al-Shehbaz, in prep.).

Tropidocarpum Hooker, Icon. Pl. t. 43. 1836. TYPE: *Tropidocarpum gracile* Hooker, Icon. Pl. t. 43. 1836.

Agallis Philippi, Linnaea 33: 12. 1864. Syn. nov. TYPE: *Agallis montana* Philippi, Linnaea 33: 12. 1864 (= *Agallis lanata* (Barnéoud) Gilg & Muschler ex O. E. Schulz, in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 17B: 418. 1936).

For a detailed description of *Tropidocarpum*, see Rollins (1993a).

Key to the Species of *Tropidocarpum*

1a. Fruit narrowly linear, (2.5–)3–6(–7) cm × 1.5–2 mm . . . . . *T. gracile*
1b. Fruit oblong to elliptic, 1–2(–2.5) cm × 3–5 mm.
  2a. Fruit valves 4; anthers oblong, 0.4–0.5 mm; fruit 25- to 40-seeded; California . . . . . *T. capparideum*
  2b. Fruit valves 2; anthers ovate, 0.15–0.25 mm; fruit 16- to 26-seeded; Chile . . . . . *T. lanatum*

Tropidocarpum lanatum (Barnéoud) Al-Shehbaz & R. A. Price, comb. nov. Basionym: *Lepidium lanatum* Barnéoud, in Gay, Fl. Chile 1: 167. 1846. TYPE: Chile. Santiago, *C. Gay s.n.* (holotype, P; photos, F, US).

Specimens examined. CHILE. **Región IV:** Fray Jorge, Las Papas, ca. 500 m, *Jiles 720* (S); Ovalle, Bosque Fray Jorge, open meadow, *Sparre 3029* (S). **Región Metropolitana:** Santiago, *Claude-Joseph 2232, 2267* (US); Lo Prado, *Claude-Joseph 2791* (US).

Acknowledgments. We thank Dean W. Taylor, Barbara Ertter (both at UC), and G. Fred Hrusa (CDA) for sending specimens of *Twisselmannia* and/or *Tropidocarpum* for our study. The curators and directors of the herbaria cited are thanked for specimen loans.

Literature Cited

Al-Shehbaz, I. A. 1990. New or noteworthy species in the South American genera *Mancoa, Pennellia,* and *Sisymbrium* (Brassicaceae). Harvard Pap. Bot. 2: 11–16.

———. 1999. *Twisselmannia* (Brassicaceae), a remarkable new genus from California. Novon 9: 132–135.

Bailey, C. D. 2001. Systematics of *Sphaerocardamum* (Brassicaceae) and Related Genera. Ph.D. Dissertation, Cornell University, Ithaca.

Boelcke, O. & M. C. Romanczuk. 1984. Cruciferae. *In:* A. Cabrera (editor), Fl. Patagonica 4a: 373–544. Instituto Nacional de Tecnologia Agropecuraria, Buenos Aires.

Holmgren, P. K. 1971. A biosystematic study of North American *Thlaspi montanum* and its allies. Mem. New York Bot. Gard. 21(2): 1–106.

Jurtzev, B. A. 1975. *Lesquerella. In:* A. I. Tolmatchev (editor), Flora Arctica URSS 7: 103–105. Academy of Sciences, Leningrad.

Price, R. A., C. D. Bailey & I. A. Al-Shehbaz. 2001. Transfer of the cupulate-flowered *Arabis microsperma* and *A. tricornuta* to *Pennellia* (Brassicaceae). Novon 11: 337–340.

Raven, P. H. 1963. Amphitropical relationships in the floras of North and South America. Quart. Rev. Biol. 38: 151–177.

Rollins, R. C. 1941. Some generic relatives of *Capsella.* Contr. Dudley Herb. 3: 185–198.

———. 1980. The genus *Pennellia* (Cruciferae) in North America. Contr. Gray Herb. 210: 5–21.

———. 1993a. *Tropidocarpum.* Pp. 447–448 *in* J. C. Hickman (editor), The Jepson Manual. Univ. of California Press, Berkeley.

———. 1993b. The Cruciferae of Continental North America. Stanford Univ. Press, Stanford.

——— & E. A. Shaw. 1973. The Genus *Lesquerella* (Cruciferae) in North America. Harvard Univ. Press, Cambridge, Massachusetts.

Schulz, O. E. 1924. Cruciferae–Sisymbrieae. *In:* A. Engler (editor), Pflanzenreich 89(IV. 105): 1–388. Wilhelm Engelmann, Leipzig.

———. 1936. Cruciferae. *In:* A. Engler & K. Prantl (editors), Nat. Pflanzenfam., ed. 2., 17B: 227–658. Verlag von Wilhelm Engelmann, Leipzig.

Wiggins, I. L. 1980. Flora of Baja California. Stanford Univ. Press, Stanford.

Four New Combinations in Eurasian *Doronicum* L. (Asteraceae, Senecioneae)

I. Álvarez Fernández

Real Jardín Botánico, Consejo Superior de Investigaciones Científicas, Plaza de Murillo 2, E-28014 Madrid, Spain

ABSTRACT. The combinations *Doronicum carpetanum* subsp. *diazii* (C. Pérez Morales & A. Penas Merino) Álvarez Fernández, *Doronicum carpetanum* subsp. *kuepferi* (R. Chacón Aumente) Álvarez Fernández, *Doronicum kamaonense* (DC.) Álvarez Fernández, and *Doronicum macrophyllum* F. E. L. Fischer subsp. *sparsipilosum* (J. R. Edmondson) Álvarez Fernández are proposed. *Doronicum kamaonense* is lectotypified.

Key words: Asteraceae, *Doronicum*, Eurasia, Senecioneae.

As a result of a taxonomic revision of the genus *Doronicum* based on 4500 herbarium specimens from 47 herbaria (Álvarez Fernández, 1999; Álvarez Fernández & Nieto Feliner, 1999), a few nomenclatural adjustments are needed. A monograph of the genus is currently being prepared, comprising 26 species and 4 subspecies distributed from the Iberian Peninsula to the Yunnan Province in China. The following new combinations are proposed.

Doronicum carpetanum Boissier & Reuter ex Willkomm & Lange subsp. **diazii** (C. Pérez Morales & A. Penas Merino) Álvarez Fernández, comb. et stat. nov. Basionym: *Doronicum diazii* C. Pérez Morales & A. Penas Merino, Lagascalia 15: 155. 1990. TYPE: Spain. León: "Puerto Bermejo (Abelgas, León), 30TTN55, praderas silíceas," July 1974, *C. Romero* (holotype, LEB 4290 not seen).

Doronicum carpetanum Boissier & Reuter ex Willkomm & Lange subsp. **kuepferi** (R. Chacón Aumente) Álvarez Fernández, comb. et stat. nov. Basionym: *Doronicum kuepferi* R. Chacón Aumente, Anales Jard. Bot. Madrid 43: 269. 1987. TYPE: Spain. Cáceres: "Cáceres: Sierra de Majarreina, lugares rupestres cerca del Pico del Telégrafo, 2400 m," 7 Aug. 1946, *Rivas Goday s.n.* (holotype, MA 155587).

Doronicum carpetanum is endemic to the northern half of the Iberian Peninsula. It is closely related to *D. grandiflorum* Lamarck, from which it differs mainly by its heterocarpic capitula and leaf shape. As a result of my study (Álvarez Fernández, 1999), I concluded that three endemic species described from the Iberian Peninsula (*D. diazii* Pérez Morales & Penas, *D. kuepferi* R. Chacón, and *D. pubescens* Pérez Morales, Penas, Llamas & Acedo) fall within the range of variation of *D. carpetanum*. However, those entities differ in plant size, ploidy level, and degree or distribution of indumentum, so that they can be distinguished in most cases. As such, I treat these taxa as subspecies of *D. carpetanum*. Since one of the required names, *D. carpetanum* subsp. *pubescens* (Pérez Morales, Penas, Llamas & Acedo) Aizpuru, was recently validated (Aizpuru et al., 1998), only the remaining two combinations are proposed here.

Doronicum kamaonense (DC.) Álvarez Fernández, comb. nov. Basionym: *Fullartonia kamaonensis* DC., Prodr. 5: 281. 1836. TYPE: "Comp. angl. des Indes," 1830 [sine collector] (lectotype, selected here, G-DC not seen, G-DC microfiche).

Doronicum roylei DC., Prod. 6: 321. Syn. nov. 1838. TYPE: "Cachemire," [acc.] 1833, *Royle 232* (lectotype, designated by Álvarez Fernández & Nieto Feliner (1999), G-DC not seen, G-DC microfiche).

The monotypic genus *Fullartonia* DC. (*F. kamaonensis* DC., 1836) has been considered as a synonym of *Doronicum roylei* DC. (1838) by several authors (e.g., Clarke, 1876; Hooker, 1881; Cavillier, 1911), and it also appears as such in *Index Kewensis* (Royal Botanic Gardens, Kew, 1997). If this criterion were right, the epithet *kamaonensis* would have priority, and it should be combined under *Doronicum*.

In the protologue of *F. kamaonensis*, De Candolle included the origin of the collection, "in Kamaon prov. Indicâ ad radices Himalayae," followed by the annotation: "(v.s. sine num. et nom. comm. ab ill. Aulâ merc. Ind. or.)." This means that this sheet did not contain any written information, and that

the origin of the plant was only obtained by oral communication from a merchant named Aulâ. In G-DC there is a single sheet of *F. kamaonensis* that contains a fragment of one specimen and three labels. One of these labels contains only the name *Fullartonia kamaonensis* DC., the second contains the name *F. kamaonensis* and also the reference to the protologue (De Candolle, Prod. 5, p. 281, n.1), and the remaining handwritten label says: "Comp. angl. des Indes 1830." Although the match between this label and the protologue is not straightforward, this is the only acceptable material for lectotypification. The handwriting seems to belong to De Candolle (Burdet, 1979), since it was written in French, and it refers to the place of origin as "des Indes." The last letter of the first word is unclear, but it could mean "Compagnie," making sense of the whole sentence: "English Company of India 1830."

Some characters suggesting that the type specimen of *F. kamaonensis* corresponds to *D. roylei* were observed by microfiche (i.e., habit, and leaf shape and venation). But to decide upon the identity of this sheet, the collaboration of A. Charpin was decisive. He checked the occurrence of the exclusive character of *D. roylei* (cup-like glandular hairs near the capitula) in this specimen, confirming that *F. kamaonensis* and *D. roylei* are the same entity. Because the former has priority, the combination *D. kamaonense* (DC.) Álvarez Fernández is needed, and *D. roylei* DC. remains as a heterotypic synonym.

Doronicum macrophyllum F. E. L. Fischer subsp. **sparsipilosum** (J. R. Edmondson) Álvarez Fernández, comb. nov. Basionym: *Doronicum bithynicum* subsp. *sparsipilosum* J. R. Edmondson, Notes Roy. Bot. Gard. Edinburgh 32: 258. 1973. TYPE: Turkey. Kastamonu: "Ilgaz Daglari, 35 km S of Kastamonu, roadside on N side of pass top, mainly under Abies, 1730 m," 27 July 1971, *J. R. Edmondson 463* (holotype, E; isotypes, G, ISTF not seen, K, W).

The genus *Doronicum* reaches its main taxonomic complexity in southwest Asia. Taxa from this area are polymorphic and their diagnostic characters, mainly based on the kind of indumentum, are few. From this area, Edmondson (1973) described *D. bithynicum* J. R. Edmondson together with a new subspecies, subsp. *sparsipilosum* J. R. Edmondson. Only two diagnostic characters were indicated by the author that discriminate *D. bithynicum* from *D. reticulatum* Boissier: basal leaves without white veins beneath, and the number of capitula. The white color of the veins depends on the density of indumentum, which is very variable. In my taxonomic treatment I conclude that *D. bithynicum* should be included within *D. reticulatum*. The latter species, *D. reticulatum*, possesses an exclusive character (ovate-lanceolate phyllaries with longitudinal veins darker than the blade) and is one of the best characterized endemic species in the Anatolian Peninsula. In contrast, Edmondson's subspecies *sparsipilosum* is quite different from *D. reticulatum* because of the lanceolate phyllaries, the lack of dark veins, and the occurrence of eglandular multiseriate hairs. In this subspecies, the shape of phyllaries and the kind of indumentum resemble *D. macrophyllum* F. E. L. Fischer, which differs slightly in its habit, size of basal leaves, and density of the indumentum. In most cases it is possible to distinguish them, and I consider it more appropriate to subordinate this subspecies to *D. macrophyllum*.

Acknowledgments. I am grateful to André Charpin and Fernand Jacquemoud for help with the type material of G-DC, to Félix Muñoz-Garmendia and Alberto Herrero for the information provided, and to Gonzalo Nieto Feliner for constructive comments. This work has been partially supported by grant DGES PB96–0849 of the Spanish Dirección General de Enseñanza Superior e Investigación Científica.

Literature Cited

Aizpuru, I., C. Aseginolaza, F. Garin & J. Vivant. 1998. Contribuciones al conocimiento de la Flora del País Vasco, III. Munibe 50: 7–19.

Álvarez Fernández, I. 1999. Sistemática del Género *Doronicum* L. (Asteraceae, Senecioneae) y Análisis Filogenético Basado en Fuentes Morfológicas y Moleculares. Unpublished Ph.D. Dissertation, Departamento de Biología Vegetal I, Facultad de Ciencias Biológicas, Universidad Complutense de Madrid, Madrid.

——— & G. Nieto Feliner. 1999. Lectotypification of 16 species names in *Doronicum* (Asteraceae, Senecioneae). Taxon 48: 801–806.

Burdet, H. M. 1979. Auxilium ad botanicorum graphicem. Genève.

Candolle, A. P. De. 1836. Prodromus systematis naturalis regni vegetabilis, 5. Paris.

———. 1838. Prodromus systematis naturalis regni vegetabilis, 6. Paris.

Cavillier, F. 1911. Nouvelles études sur le genre *Doronicum*. Annuaire Conserv. Jard. Bot. Genève 13–14: 195–368.

Clarke, C. B. 1876. Compositae Indicae. London.

Edmondson, J. R. 1973. Notes on *Doronicum* L. in SW Asia. Notes Roy. Bot. Gard. Edinburgh 32: 255–258.

Hooker, J. D. 1881. The Flora of British India. London.

Royal Botanic Gardens, Kew. 1997. Index Kewensis 2.0 on CD-Rom. Oxford Univ. Press, Oxford.

Dolichorhynchus is United with *Douepea* (Brassicaceae)

Oliver Appel
Bredkamp 36E, 22589 Hamburg, Germany

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.

ABSTRACT. The monotypic *Dolichorhynchus* is reduced to the synonymy of *Douepea*. The new combination *Douepea arabica* is proposed.

Key words: Brassicaceae, *Dolichorhynchus*, *Douepea*.

During work on the Brassicaceae (Cruciferae) account for Kubitzki's *Families and Genera of Vascular Plants*, it became evident that the generic limits of several closely related pairs of genera are based on fine differences in character states of little taxonomic value. A case in point are the monotypic genera *Dolichorhynchus* Hedge & Kit Tan (Saudi Arabia) and *Douepea* Cambessèdes (Pakistan). Hedge and Tan provided a detailed description of *Dolichorhynchus* and indicated (1987: 200) that "Despite the very great geographical separation of *Douepea* and the new genus . . ., the two genera are quite similar in facies and share several morphological similarities." In fact, our critical comparison of *Dolichorhynchus arabicus* Hedge & Kit Tan and *Douepea tortuosa* Cambessèdes shows that the two species are basically indistinguishable in being suffrutescent, glabrous, and glaucous perennials with oblong-elliptic, short-petiolate, lower cauline leaves, semi-amplexicaul upper leaves, subequal, erect, oblong to oblong-lanceolate sepals, oblong to lingulate petals undifferentiated into blade and claw, well-developed median nectar glands, narrowly oblong, basally sagittate, apiculate anthers, 20- to 30-ovulate ovaries, strongly 2-lobed stigmas with distinctly decurrent lobes, linear-cylindric siliques, rigid valves, ellipsoid seeds ca. 2 mm long, and conduplicate cotyledons.

The only significant differences that we can detect between these two species are the presence in *Dolichorhynchus arabicus* of white flowers and well-developed styles 2–2.5 cm long. By contrast, *Douepea tortuosa* has pink to violet petals and short styles ca. 0.5 cm long. Hedge and Tan (1987) indicated that the seeds of *Dolichorhynchus arabicus* are more than 2 mm long and those of *Douepea tortuosa* are less than 1 mm long. However, all the material of *Douepea tortuosa* that we and Jafri (1973) examined have seeds ca. 2 mm long. In our opinion, the above differences between the two species do not justify their placement in independent genera, and the similarities between them clearly support their treatment in the same genus. In fact, genera such as *Brassica* L. (ca. 40 spp.), *Sinapis* L. (7 spp.), *Raphanus* L. (3 spp.), *Vella* L. (7 spp.), and *Coincya* Rouy (6 spp.), all of which are members of the tribe Brassiceae, show habit, floral, fruit, and seed diversity far greater than those separating *Dolichorhynchus* and *Douepea*. The two genera are united formally herein to make the new combination available for the forthcoming volume of the *Families and Genera of Vascular Plants*.

Hooker and Thomson (1861) reduced *Douepea* (as *Douepia*) to the synonymy of *Moricandia* DC., but it is clear that the two genera are quite distinct. *Douepea* has well-developed median nectar glands, cuneate upper cauline leaves neither amplexicaul nor sagittate at base, non-connivent sepals with the lateral pair not saccate, and 20 to 40 ovules per ovary. In contrast, *Moricandia* lacks the median nectar glands and has upper cauline leaves with amplexicaul to sagittate bases, connivent sepals with the lateral pair saccate, and (30 to) 80 to 200 ovules per ovary.

Douepea Cambessèdes, in Jacquemont, Voy. Inde 4: 18. 1844. TYPE: *Douepea tortuosa* Cambessèdes, in Jacquemont, Voy. Inde 4: 18. 1844.

Dolichorhynchus Hedge & Kit Tan, Pl. Syst. Evol. 156: 197. 1987. Syn. nov. TYPE: *Dolichorhynchus arabicus* Hedge & Kit Tan.

Douepea arabica (Hedge & Kit Tan) O. Appel & Al-Shehbaz, comb. nov. Basionym: *Dolichorhynchus arabicus* Hedge & Kit Tan, Pl. Syst. Evol. 156: 198. 1987. TYPE: Saudi Arabia. North Hijaz, Wadi Qaraqir, 50 km E of Duba, on Tabuk road (at turn off 10 km W of Duba), sandstone ledge in narrow ravine, growing with *Nerium oleander,* 600 m, 14 Mar. 1986, *I. S. Collenette 5478* (holotype, E; isotype, K).

Literature Cited

Hedge, I. C. & K. Tan. 1987. Two remarkable new Cruciferae from Saudi Arabia. Pl. Syst. Evol. 156: 197–206.

Hooker, J. D. & T. Thomson. 1861. Praecursores ad Floram Indicam. J. Proc. Linn. Soc., Bot. 5: 128–181.

Jafri, S. M. H. 1973. Brassicaceae. *In:* E. Nasir & S. I. Ali (editors), Fl. West Pakistan 55: 1–308. Ferozsons, Karachi.

Una Nueva Especie de *Sessea* (Solanaceae) de Loja, Ecuador

Carmen Benítez

Facultad de Agronomía, Instituto de Botánica Agrícola, Universidad Central de Venezuela, Maracay 2101 Estado Aragua, Venezuela

Resumen. Se describe e ilustra una nueva especie de Solanaceae de la Provincia de Loja, Ecuador, *Sessea jorgensenii* Benítez. Esta nueva especie se distingue de otras especies de *Sessea* de la provincia de Loja por presentar sus hojas densamente dendrítico-pubescentes en el envés y también con algunos pelos dispersos de color negro, simples o bifurcados y con la base túmida, este último tipo de pelo también presente en tallos, pecíolos, ejes florales, cáliz, corola y en las valvas de los frutos; siendo sus flores ligeramente curvadas, el cáliz de 11.5–13 mm de largo, cubriendo a la corola en su mitad inferior y la cápsula cubierta en sus tres cuartas partes por el cáliz persistente.

Abstract. A new species of Solanaceae from the Province of Loja, Ecuador, *Sessea jorgensenii* Benítez, is described and illustrated. The new species is distinguished from other species of *Sessea* from the Province of Loja by the leaves densely dendritic-pubescent below as well as bearing scattered black, simple or bifurcated hairs with swollen bases; this latter type of hair is also found on stems, petioles, floral axes, calyx, corolla, and valves of the fruit. It also differs in having slightly curved flowers with the calyx 11.5–13 mm long and covering the basal half of the corolla and three-fourths of the capsular fruit.

Key words: Ecuador, *Sessea*, Solanaceae.

El género Neotropical *Sessea* Ruiz & Pavón (Solanaceae) comprende unas 18 especies concentradas en los Andes suramericanos (Venezuela, Colombia, Ecuador, Perú y Bolivia), siendo estos, centros de diversidad del género, especialmente las Cordilleras Central de Colombia y Oriental de Ecuador. *Sessea* fue revisado por Bitter (1922) y Francey (1934) y desde esos tiempos estudios del género han sido referidos a descripciones individuales de nuevas especies, nuevas combinaciones especialmente aquellas hechas por Macbride (1962) y como parte de tratamientos florísticos. Carvalho y Schnoor (1993/1997) en su comparación analítica entre *Sessea* y *Cestrum* consideran a *Sessea* como una sección de *Cestrum*.

Las características morfológicas que sustentan la separación de *Cestrum* y *Sessea* se expresan en la siguiente clave:

1a. Fruto una cápsula, semillas aladas, ovario 4-lobado y pubescente, estigma irregularmente bilobado, los lobos desiguales hasta completamente deflexos . . . . . *Sessea*

1b. Fruto una baya, semillas no aladas, ovario entero, glabro, estigma regularmente bilobado, los lobos iguales . . . . . *Cestrum*

En base a los caracteres morfológicos mencionados en la clave, los cuales han sido analizados en el estudio que actualmente realizo en el género *Sessea*, justifican el mantener separados ambos géneros, considerando además que en recientes esquemas filogenéticos basados en el ADN del cloroplasto, *Sesssea* ha quedado incluido como uno de los 4 miembros de la tribu Cestreae (Olmstead & Palmer, 1992; Olmstead et al., 1999).

El género *Sessea* está representado en Ecuador por cerca de 9 especies (Benítez de Rojas, 2000), 2 de las cuales son endémicas a dicho país, siendo la nueva especie aquí descrita simpátrica con *Sessea corymbiflora* Goudot ex Richard Taylor & R. Phillips, *S. macrophylla* Francey y *S. sodiroi* Bitter. En el tratamiento en desarrollo del género *Sessea* para el Neotrópico, encontré unos pocos especímenes de herbario cuyas características los hacen diferentes a especies ya conocidas del género, pudiéndose determinar que se trata de una especie aún no descrita, la cual se describe, discute e ilustra en el presente trabajo.

Sessea jorgensenii Benítez, sp. nov. TIPO: Ecuador. Loja: Cerro Sozoranga, Cariamanga–Utuana road, km 29.5, 2610 m, 04°21′19″S, 79°42′08″W, 29 abr. 1994, *P. M. Jørgensen, C. Ulloa, H. Vargas & G. Avendaño 627* (holótipo, MO; isótipos, AAU, GB, LOJA, MEXU, NY, QCA, QCNE). Figura 1.

Frutex vel arbor parva foliis subtus dense pubescentibus, pilis saepissime dendriticis, paulo dispersis, negris, simplicibus vel bifurcatis, basi tumida, negra. Ramuli, inflorescentiae floresque pilis dendriticis simplicibus vel bifurcatis, negris, praediti. Calyx 11.5–13 mm longus, asymmetrice incisus, corollam in dimidio inferiore obtegens. Corolla parum curvata, 22–24 mm longa; ovarium stipiti 3 mm longo insidens. Calyx ¾ capsulae obtegens.

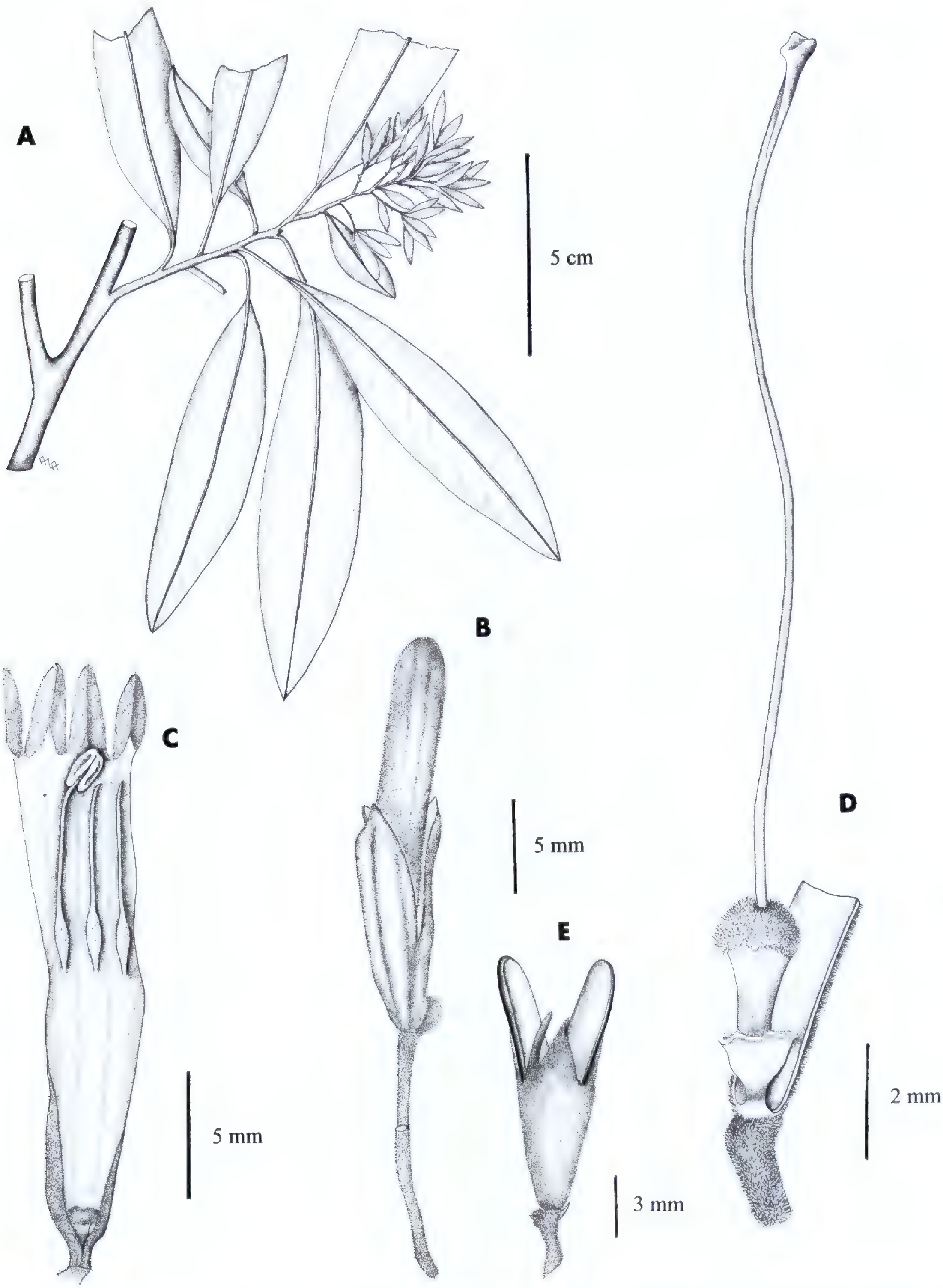


Figura 1. *Sessea jorgensenii* Benítez. —A. Rama con yemas florales. —B. Bóton floral. —C. Corola disectada mostrando los estambres. —D. Gineceo incluyendo el estípite y la porción basal del tubo de la corola. —E. Cápsula incluida en el cáliz persistente. Basada en holótipo, *Jørgensen et al. 627.*

Arbusto o árbol de hasta 4 m de alto, ramas subteretes, las jóvenes densamente pubescentes, con pelos dendríticos y pelos simples o bifurcados con la base túmida, de color negro, estos últimos dispersos en tallos, ejes florales, pecíolos, flores y valvas de la cápsula; tallos adultos estriados y rugosos; entrenudos de 1.5–2 cm de largo. Hojas subcoriáceas, con el margen revoluto; pecíolo 10–25 × 1–1.5 mm, canaliculado, con pelos dendríticos adpresos. Lámina elíptica u obovada, 9–12 × 2–2.6 cm, relación largo: ancho = 4.5–4.6:1, base aguda, ligeramente desigual, el ápice agudo o atenuado, en la haz glabra y reticulado-venosa, venas hundidas; el envés densamente pubescente, con pelos dendríticos y adpresos a la lámina, marcando las venas laterales que son ligeramente elevadas y en número de 9 a 12/lado, venación terciaria inconspícua. Inflorescencia en panículas terminales, multifloras, laxas, de 6–10 cm de largo, racimos compuestos, de 3–4 cm de largo. Flores amarillo-cremosas, de 2.2–2.4 cm de largo, aproximadas, ligeramente curvadas, sésiles, la boca de 3.5–4 mm de diám., la bráctea 2 × 1.5 mm, laminar, gruesa y densamente pubescente. Botones florales alargados, curvados, de 9–10 mm de largo, con los nervios salientes. Cáliz 11.5–13 × 3–4 mm, membranáceo y transparente en su mitad superior, coriáceo en su mitad inferior, densamente pubescente, con pelos adpresos, dendríticos y con brazos cortos, el tubo 5-nervado, los nervios elevados y conspicuamente rematandos en el ápice de los lobos, el tubo de 11–12.4 mm de largo, los lobos 0.5 × 0.5 mm, irregularmente partidos y subespatáceos. Corola de 22–24 mm de largo, densamente pubescente, con pelos adpresos, dendríticos y con brazos cortos, el tubo de 17–20.5 mm de largo, los lobos 2.6–3.5 × 1.5–1.6 mm, triangulares, con los pliegues introflexos. Filamentos estaminales adnatos al tubo de la corola por 9–11 mm de largo, la parte libre de 5–7 mm de largo, en la inserción y por 1.5 mm de largo geniculado-túmida y ligeramente pilosa; anteras 1.4–1.5 × 0.7–1 mm, elipsoideas. Ovario subgloboso, de 1.25 mm de diám., densamente pubescente, 4-valvado, las valvas con el ápice mucronado, el estípite de 3 mm de largo, obcónico, estilo de 17–19 mm de largo, sublaminar, papiloso por 3 mm abajo del estigma, este irregularmente bilobado. Fruto en cápsula 12 × 3 mm, cubierta por el cáliz en sus ¾ partes, las valvas coriáceas, con el ápice fuertemente cuculado. Semillas no vistas.

Entre las especies del género, *Sessea jorgensenii* Benítez es semejante en apariencia a *S. crassivenosa* Bitter, de las cordilleras Oriental y Occidental en Ecuador, sin embargo, *S. jorgensenii* tiene el cáliz de mayores dimensiones, 11.5–13 mm de largo, es irregularmente lobado y subespatáceo, siendo en su mitad inferior coriáceo y en la superior membranáceo, en tanto que en *S. crassivenosa* el cáliz es submembranáceo en toda su extensión, mide 4–8 mm de largo y los lóbulos son ancho-triangulares y apiculados. Otro carácter diagnóstico que diferencia estas especies es el tamaño de la corola y del estípite, siendo la corola en *S. jorgensenii* de 22–24 mm de largo y el estípite de 3 mm de largo, en tanto que en *S. crassivenosa* la corola mide 13.5–15 mm de largo y el estípite 1 mm de largo.

Respecto a las otras especies simpátricas con *S. jorgensenii* que crecen en la provincia de Loja: *S. corymbiflora* presenta sus corolas de 9–13 mm de largo y el envés de la hoja es glabro, *S. macrophylla* tiene corolas que alcanzan medidas entre 16–17.5 mm de largo y el envés de la hoja presenta pubescencia estrellado-lanuginosa y, finalmente *S. sodiroi* que aunque en el envés de la hoja presenta el mismo tipo de pubescencia que *S. jorgensenii*, sus corolas miden 16–18 mm de largo y el cáliz es subpapiráceo y mide de 6–8.5 mm de largo.

Distribución y ecología. *Sessea jorgensenii* se encuentra en la Provincia de Loja, en el sur de Ecuador, creciendo en arbustales y restos de selvas montanas correspondientes al Callejón Interandino, a elevaciones entre 2100 y 2610 m. Florece en abril y fructifica en diciembre.

El epíteto específico honra al botánico danés Peter M. Jørgensen (MO), por sus valiosas colecciones botánicas en Ecuador, contribuyendo así al conocimiento de la interesante flora de ese país.

Parátipos. ECUADOR. **Loja**: El Cisne-Gualel, km 2.9, shrubby vegetation and remnants of montane forest, 2190 m, 03°49′49″S, 79°25′13″W, 14 Dec. 1994, *P. M. Jørgensen, C. Ulloa, H. Vargas & P. Lozano 1512* (LOJA, MO, QCA, QCNE).

Agradecimientos. Al Consejo de Desarrollo Científico y Humanístico de la Universidad Central de Venezuela por su apoyo financiero, al Missouri Botanical Garden por su hospitalidad durante mis visitas científicas para estudiar Solanaceae. A Henk van der Werff por la traducción en latín, a M. Nee por la revisión del manuscrito. La magnífica ilustración fue hecha por Alba Arbeláez.

Literatura Citada

Benítez de Rojas, C. 2000. The Neotropical genus *Sessea* (Solanaceae): A preliminary survey. [Abstracts] V International Solanaceae Conference, Nijmegen, the Netherlands.

Bitter, G. 1922. Zur Gattung *Sessea*. Repert. Spec. Nov. Regni Veg. 18: 199–215.

Carvalho, L. & A. Schnoor 1993/1997. *Sessea* Carvalho et Schnoor—nova seção para o gênero *Cestrum* (Solanaceae). Rodriguesia 45/49, (71/75): 15–24.

Francey, P. 1934. Übersicht über die Gattung *Sessea*. Notizbl. Bot. Gart. Berlin-Dahlem 11: 978–990.

Macbride, J. F. 1962. Flora of Peru. Field Mus. Nat. Hist. Bot. Ser. (V-B) Number 1: 87–123.

Olmstead, R. G. & J. D. Palmer. 1992. A chloroplast DNA phylogeny of the Solanaceae: Subfamilial relationships and character evolution. Ann. Missouri Bot. Gard. 79: 346–360.

———, J. A. Sweere, R. E. Spangler, L. Bohs & J. D. Palmer. 1999. Phylogeny and provisional classification of the Solanaceae based on chloroplast DNA. Pp. 111–137 *in* M. Nee, D. Symon, J. Jessup & J. G. Hawkes (editors), Solanaceae IV: Advances in Biology and Utilization. The Royal Botanic Gardens, Kew.

Two New Names in Chinese *Stellaria* (Caryophyllaceae)

Chen Shilong
North-western Plateau Institute of Biology, Chinese Academy of Sciences, 57 Xiquan Street, Xining, Qinghai 810001, People's Republic of China

Richard K. Rabeler
University of Michigan Herbarium, 1205 N. University Ave., Ann Arbor, Michigan 48109-1057, U.S.A.

Nicholas J. Turland
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri, 63166-0299, U.S.A.

ABSTRACT. During preparation of the account of *Stellaria* L. (Caryophyllaceae) for the *Flora of China*, Volume 6, it was noticed that two names are illegitimate later homonyms: *Stellaria arenaria* Maximowicz, non Linnaeus, and *Stellaria pilosa* Franchet, non Dulac. Therefore, the following new names (nomina nova) are provided here: *Stellaria arenarioides* Shi L. Chen, Rabeler & Turland and *Stellaria pilosoides* Shi L. Chen, Rabeler & Turland.

Key words: Caryophyllaceae, China, *Stellaria*.

Stellaria arenarioides Shi L. Chen, Rabeler & Turland, nom. nov. Replaced synonym: *Stellaria arenaria* Maximowicz, Fl. Tangut. 91. 1889, non Linnaeus, Sp. Pl. 2: 1196. 1753. TYPE: China. Xizang [Tibet]: "Dzhagin-gol," 23 July 1884, *Przewalski s.n.* (holotype, LE not seen).

Stellaria arenaria Maximowicz (1889) was originally described from Xizang Autonomous Region (Tibet), China. Unfortunately, the name is illegitimate under Article 53.1 of the *Saint Louis Code* (Greuter et al., 2000) because an earlier homonym exists: *S. arenaria* L. (1753). The latter name was described from Spain and is now treated as *Arenaria hispanica* Sprengel (see López González, 1990). Maximowicz's species will be accepted by Chen and Rabeler (in press) in their forthcoming account of *Stellaria* in the *Flora of China*, Volume 6, as occurring in Gansu, Qinghai, Xinjiang, and Xizang provinces and autonomous regions. Therefore a new name (nomen novum) for the Chinese species is required, and *S. arenarioides* Shi L. Chen, Rabeler & Turland is provided here. *Stellaria arenarioides* is a member of a small group of central Asian *Stellaria* species, often recognized as *Stellaria* sect. *Adenonema* (Bunge) Turczaninow, characterized by a densely cushion-like habit, petals shorter than sepals, 2 or 3 styles (see Kozhevnikov, 1983, for inclusion of bistylous species), many ovules, 4 or 6 capsule valves, and 1 or 2 (to 8) seeds. *Stellaria arenarioides* is distinguished from other members of this group by having small stature (5–7 cm tall), stems that are glabrous proximally and pubescent distally, ovate to ovate-lanceolate leaves, 3 styles, and 6 capsule valves.

Stellaria pilosoides Shi L. Chen, Rabeler & Turland, nom. nov. Replaced synonym: *Stellaria pilosa* Franchet, Pl. Delavay. 99. 1889, non Dulac, Fl. Hautes-Pyrénées, 250. 1867. TYPE: Yunnan. "Ad oras silvarum ad collum Koua-la-po (Hokin)," 3000 m, 13 July 1886 (fl), *P. J. M. Delavay 2155* (holotype, P not seen).

Stellaria pilosa Franchet (1889) was originally described from Yunnan Province, China. Unfortunately, the name is illegitimate under Article 53.1 of the *Saint Louis Code* (Greuter et al., 2000) because an earlier homonym exists: *S. pilosa* Dulac (1867). This earlier homonym is itself illegitimate under Article 52.1 because it was nomenclaturally superfluous when published, i.e., when *S. media* (L.) Villars was cited in the synonymy of *S. pilosa* Dulac, the type of *Alsine media* L. (1753) was definitely included (Article 52.2(e)) and its epithet ought to have been adopted. Nevertheless, Article 53 Note 1 rules that the later homonym (*S. pilosa* Franchet) is unavailable for use even if the earlier homonym is illegitimate. Franchet's species will be accepted by Chen and Rabeler (in press) in their forthcoming account of *Stellaria* in the *Flora of China*, Volume 6, as endemic to Sichuan and Yun-

nan provinces. Therefore a new name (nomen novum) for this Chinese species is required, and *S. pilosoides* Shi L. Chen, Rabeler & Turland is provided here. *Stellaria pilosoides* is probably most closely related to *Stellaria petiolaris* Handel-Mazzetti. The former species is distinguished from *S. petiolaris* by having oblong-lanceolate leaves that are pilose on both surfaces, petals slightly shorter than the sepals, and 10 stamens.

Literature Cited

Chen, S. L. & R. K. Rabeler. In press. *Stellaria* Linnaeus. *In:* Z. Y. Wu & P. H. Raven (editors), Flora of China, Vol. 6, Caryophyllaceae–Lardizabalaceae. Science Press, Beijing, & Missouri Botanical Garden Press, St. Louis.

Franchet, A. 1889–1890. Plantae Delavayanae. Paul Klincksieck, Paris.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Kozhevnikov, Yu. P. 1983. Genus *Stellaria* L. (Caryophyllaceae) in Asia Centralis. Novosti. Sist. Vyssh. Rast. 20: 94–107.

López González, G. 1990. *Arenaria* L. Pp. 172–224 *in* S. Castroviejo, M. Laínz, G. López González, P. Montserrat, F. Muñoz Garmendia, J. Paiva & L. Villar (editors), Flora Iberica, 2. Real Jardín Botánico, C.S.I.C., Madrid.

Maximowicz, C. J. 1889. Flora Tangutica, 1. Imperial Academy of Sciences, St. Petersburg.

A New Species and New Combinations in *Roldana* (Asteraceae: Senecioneae) from Mexico

A. Michele Funston
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. Revisionary studies of *Roldana* show that the following new combinations should be made: *R. anisophylla* (Klatt) Funston, *R. gonzalezi* (B. L. Turner) Funston, *R. hirsuticaulis* (Greenman) Funston, *R. mezquitlanensis* (B. L. Turner) Funston, *R. neogibsonii* (B. L. Turner) Funston, and *R. sundbergii* (B. L. Turner) Funston. The species *R. tlacotepecana* Funston was also discovered and is newly described here. It is a small perennial herb with a 1- to 3-headed paniculate cyme and radiate capitula. The distribution is restricted to the pine-oak forests of Cerro Teotepec in the mpio. Tlacotepeca, Guerrero, Mexico.

Key words: Asteraceae, Mexico, *Roldana*, Senecioneae.

The genus *Roldana* La Lave & Lexarza contains ca. 50 species and is distributed in the highlands from southern Arizona southward to Panama. It is a segregate of *Senecio* L. (Barkley et al., 1996). In a series of papers on the genera of Senecioneae in Mexico and Central America, Robinson and Brettell (1973a, 1973b, 1973c, 1974) were the first modern workers to recognize the genus. In my dissertation (Funston, 1999 unpublished) I showed that six additional combinations should be made and one new species recognized. The majority of these combinations are simple transfers from *Senecio* to *Roldana*, based on their morphological affinities to other species in *Roldana*. The newly described species *R. tlacotepecana* is morphologically intermediate between *R. pinetorum* and *R. metapeca*. Its capitula is similar in form to *R. pinetorum*, while the leaf morphology is similar to *R. metapeca*. *Roldana tlacotepecana* grows on rocky slopes at elevations of 2900–3500 m in Guerrero, Mexico.

In my dissertation I grouped the species of *Roldana* into six artificial clades based on similar habit and distribution. *Roldana gonzalezi*, *R. hirsuticaulis*, *R. neogibsonii*, and *R. sundbergii* are part of a group of species that is made up predominantly of woody shrubs and small trees that have a persistent tomentum, which may be tawny on the stem, and a dense lanate tomentum on the undersurfaces of the leaves. *Roldana gonzalezi* and *R. sundbergii* are perennial herbs but were included due to their tawny pubescence. The species of *Roldana* with this form of habit are concentrated about the Transmexican Volcanic Belt and Sierra Madre del Sur, but also extend northward along both the Sierra Madre Oriental and Occidental as well as southward into Central America.

Roldana gonzalezi (B. L. Turner) Funston, comb. nov. Basionym: *Senecio gonzalezae* B. L. Turner, Phytologia 57: 377. 1985. TYPE: Mexico. Durango: mpio. de Mezquital, 3 km S de Sta. Ma. de Ocotan, 17 Oct. 1984, *M. González 1558* (holotype, TEX not seen).

Specimen examined. MEXICO. **Jalisco:** 74 km WNW of Huequilla El Alto, Jalisco near Canoas, mpio. Mezquital, 2700 m, 22 Oct. 1983, *D. E. Breedlove 59182* (CAS).

Roldana hirsuticaulis (Greenman) Funston, comb. nov. Basionym: *Senecio hirsuticaulis* Greenman, Publ. Field Columbian Mus., Bot. Ser. 2: 280. 1907. TYPE: Mexico. San Luis Potosí: en route from San Luis Potosí to Tampico, Dec. 1878 to Feb. 1879, *E. Palmer 1114* (holotype, GH; isotype, NY).

Additional specimens examined. MEXICO. **Nuevo León:** trail from Potrero Redondo to Laguna Sanchez, mpio. Villa Santiago, 16 Aug. 1939, *Muller 2748* (GH, MICH, UC). **San Luis Potosí:** chiefly in the region of San Luis Potosí, 22°N latitude, 2000–2500 m, 1878, *Parry & Palmer 539* (GH). **Tamaulipas:** 5 mi. NW, vicinity of Gomez Farias, *Harrell 359* (MO); W of Gomez Farias on road to Rancho del Cielo, *McCarten 2605* (MICH); N of Frank Harrison's, Rancho del Cielo, in Sierra de Guatemala above Gomez Farias, *Sharp 52267* (NY).

Roldana neogibsonii (B. L. Turner) Funston, comb. nov. Basionym: *Senecio neogibsonii* B. L. Turner, Brittonia 37: 119. 1985. TYPE: Mexico. Veracruz: mpio. Huayacocotla, orilla del camino entre Helechales y Ocotes (20°39′N, 98°26′W), 1750 m, 2 Oct. 1980, *J. García P. 177* (holotype, XAL not seen).

Specimens examined. MEXICO. **Hidalgo:** Zacualtipán, 1800 m, Jan. 1940, *Martínez s.n.* (F); Zacualtipán, 1800 m, 15 Dec. 1939, *Martínez s.n.* (GH). **Puebla:** mts.

W of Huauchinango, 1 Nov. 1943, *Lundell 12633* (MICH); Puente Madera, SE of Tepehuaquila, road to Zacatepec, mpio. Huauchinango, 20°5′N, 98°2′W, 2000 m, 26 Feb. 1987, *Tenorio L. 12688* (KSC).

Roldana sundbergii (B. L. Turner) Funston, comb. nov. Basionym: *Senecio sundbergii* B. L. Turner, Brittonia 37: 117. 1985. TYPE: Mexico. Nuevo León: mpio. Galeana, ca. 25 km S of Iturbide, along main road to Agua Blanca, 10.6 km W of Ejido la Purísima, ca. 2100 m, in open pine-oak forest, 27 Oct. 1982, *S. Sundberg et al. 1921* (holotype, TEX not seen; isotypes, KSC, NY).

Additional specimens examined. MEXICO. **Nuevo León:** areas cercanas a Cola de Caballo, 100°10′W, 25°23′N, 27 Oct. 1982, *J. A. Villarreal V-4204* (KSC); areas cercanas a Cola de Caballo, bosque mesofilo de montaña, 100°10′W, 24°23′N, 100 m, 24 Oct. 1987, *J. A. Villarreal 5546* (MO).

Roldana mezquitlanensis is part of a group of species in *Roldana* that are woody shrubs and small trees that have a stipitate glandular pubescence, which includes multicelled trichomes. The species are principally distributed in the highlands of Guatemala and Central America. However, *R. mezquitlanensis* and *R. hintonii* are the two exceptions, occurring in the Sierra Madre Occidental and Transmexican Volcanic Belt, respectively.

Roldana mezquitlanensis (B. L. Turner) Funston, comb. nov. Basionym: *Senecio mezquitlanensis* B. L. Turner, Phytologia 71: 56. 1991. *Senecio gesnerifolius* B. L. Turner, Phytologia 62: 75–77. 1987, non *S. gesnerifolius* Cuatrecasas, Fieldiana, Bot. 27: 33. 1950. TYPE: Mexico. Durango: mpio. De Mezquital, 26.5 km de La Guajolota por el camino a Platanitos, bosque de enzion-pino, 2610 m, 15 Mar. 1985, *M. González 1677* (holotype, TEX not seen).

Senecio mezquitlanensis was Turner's replacement name for the later homonym *S. gesnerifolius* B. L. Turner.

I have seen only an illustration of this species. However, both Billie Turner (pers. comm.) and Jose Luis Villaseñor (pers. comm.) agree that it should be placed in *Roldana*.

Roldana anisophylla is a suffruticose shrub with stipitate-glandular pubescence. It grows in the Sierra Madre del Sur mountain range. This makes it similar to a group of ca. 10 other species in *Roldana* that are primarily distributed throughout the Transmexican Volcanic Belt, with southern extensions into the Sierra Madre del Sur and northern species along the Sierra Madre Oriental.

Roldana anisophylla (Klatt) Funston, comb. nov. Basionym: *Senecio anisophyllus* Klatt, Leopoldina 24: 124. 1888. TYPE: Mexico. Oaxaca: Pelado, *Liebmann 160* (holotype, GH not seen; isotypes, GH drawing, MO tracing).

Roldana cronquistii H. Robinson & Brettell, Phytologia 27: 417. 1974. Syn. nov. *Senecio cronquistii* (H. Robinson & Brettell) B. L. Turner & T. M. Barkley, Phytologia 67: 392. 1989. TYPE: Mexico. Oaxaca: in wet forest 1 mi. or less S of the pass between Oaxaca and Tuxtepec, 65 mi. N of Oaxaca, alt. 9300 ft., slender shrub 1–2 m tall, with (4)5(6) rays, heads yellow, 11 Oct. 1962, *A. Cronquist 9648* (holotype, US not seen, F photo, GH photo, MO photo; isotypes, GH, KSC, MICH, NY).

Roldana cronquistii was described by Robinson and Brettell, in part, based upon their agreement with Gibson's (1969) circumscription of *Senecio hederifolius* Hemsley, under which he placed the three species *S. alienus* Robinson & Seaton, *S. chrismarii* Greenman, and *S. anisophylla* Klatt in synonymy. Robinson and Brettell separated *R. cronquistii* from *R. hederifolia* based on its having more prominent bracts in the inflorescence and under the capitula, and having much larger rays. While these characters do separate *R. cronquistii* from *R. hederifolia*, they do not separate it from the type of *S. anisophyllus*. Furthermore, Gibson reported the type of *S. hederifolius* as coming from Pilado in Oaxaca; however, I can find no evidence of this, only that it is from Mexico. Therefore, until otherwise confirmed, *R. hederifolia*'s distribution is restricted to the states of México and Michoacán, while *R. anisophylla* is restricted to Oaxaca.

Additional specimens examined. MEXICO. **Oaxaca:** 43 km N of Ixtlan-de Juarez jct., on road to Valle Nacional, 2870 m, 11 Sep. 1983, *D. E. Breedlove 60015* (CAS); carretera Ciudad de Oaxaca a Tuxtepec, cerca del Cerro Pelon, mpio. Yolox, 2850 m, 18 Jan. 1989, *Cházaro B. 5809* (WIS); N of Oaxaca, 63.1 mi. N of the junction of Hwys. 175 and 190, 17 Dec. 1977, *Funk 2720* (OS); backwoods N of Localotepec mt. Peak, 3000 m, 11 Dec. 1940, *Krueger 52* (GH, MO); km 130 Oaxaca-Tuxtepec en la carretera, 10 Sep. 1963, *MacDougall s.n.* (CAS).

Roldana tlacotepecana Funston, sp. nov. TYPE: Mexico. Guerrero: mpio. Tlacotepec, bosque de Pino en talud rocoso, 19.5 km al NE de Puerto del Gallo, camino Atoyac–Filo de Caballo, hierba de 60 cm, flor. amarilla, 2900 m, 23 Nov. 1983, *E. Martínez S. 5648* (holotype, KSC). Figure 1.

Haec species *Roldanae metepecae* (B. L. Turner) C. Jeffrey etiam *R. pinetorum* (Hemsley) H. Robinson & Brettell at videtur arcte affinis, sed a hac lamina foliari ovato-orbiculari basi cordata, ab illa capitulis radiatis distinguitur.

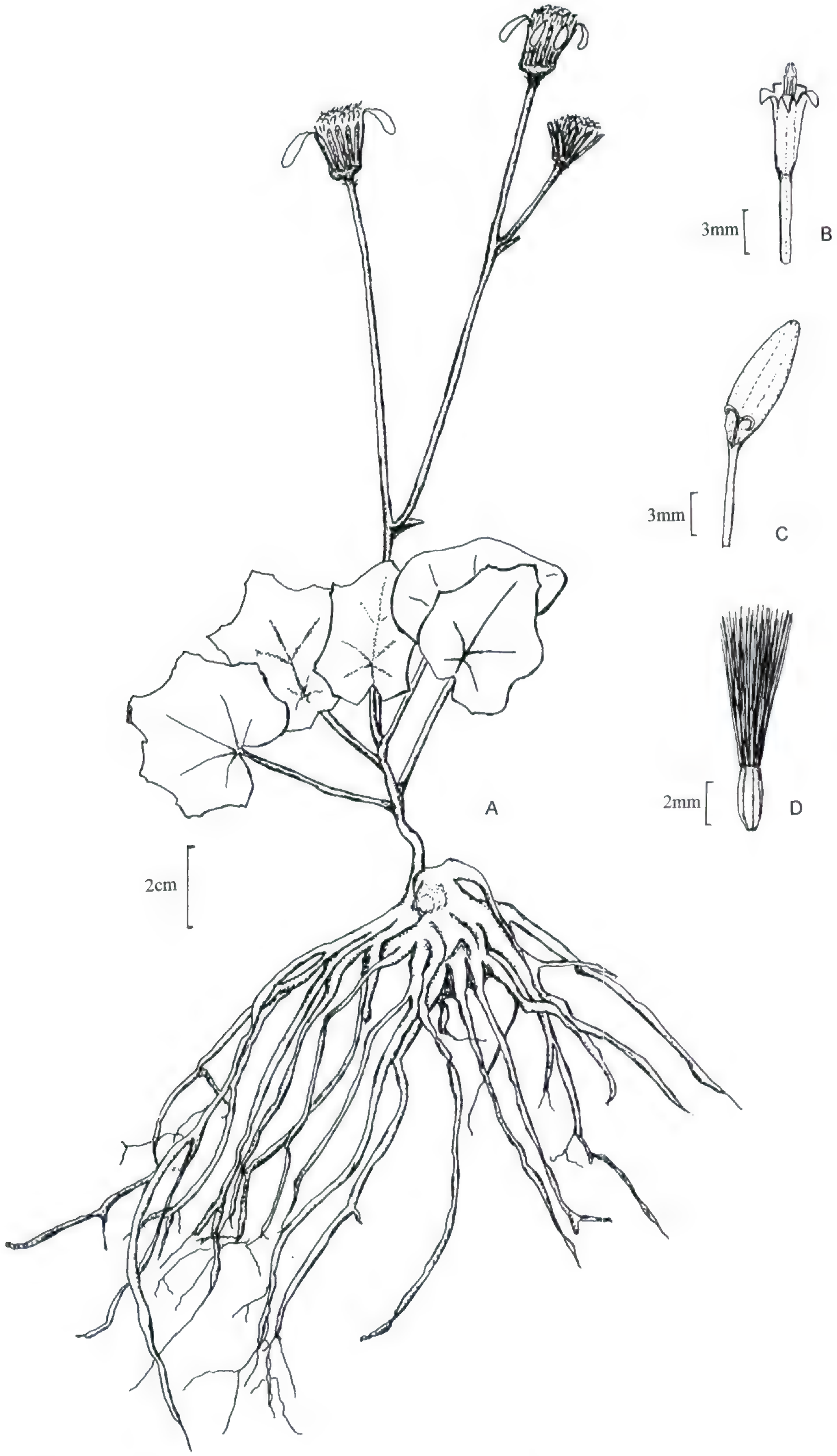


Figure 1. *Roldana tlacotepecana* Funston. —A. Habit. —B. Disc floret. —C. Ray floret. —D. Cypsela. Drawn by Funston from *E. Martínez S. 5648* and *Feddema 2918*.

Perennial herbs 20–50 cm high, arising from a rhizomatous lanate caudex, stems terete, purplish red, sparsely lanate-pubescent to tomentose in leaf axils. Leaves crowded at base to rosetteform, simple, alternate; petiole 1.5–7 cm long, sparsely pubescent with woolly trichomes or floccose, purplish red; blade 3.5–7 × 4–7 cm, ovate-orbicular, cordate at base, palmately to subpinnately veined, with ca. 6 acuminate to acute lobes 0.5–1.5 × 1–2 cm, with minute secondary lobing of callous denticles; upper blade surface glabrous, dull green, lower surface tomentose, becoming lightly so with age, greenish tan. Capitulescence a 1- to 3-headed paniculate cyme; scapiform peduncles 4.5–14 cm long; pedicels 3–8 cm long, sparsely covered with woolly trichomes at base, becoming tomentose above; bracts foliaceous, 1.5–2 × 0.5–2 cm; bracteoles linear, 10–15 × 0.5–2 mm; calyculate bracts 3 to 5, linear, 5–7 mm long, ca. 0.5 mm wide; bracteoles and calyculate bracts sparsely pubescent with woolly trichomes, deep purplish red; capitula radiate, erect at anthesis; involucre turbinate, ca. 15 mm long, 5–7 mm across at base; receptacle flat, naked, alveolate; involucral bracts ca. 14 in one apparent series, margins overlapping, the inner series with hyaline margins, linear-oblanceolate, apex acuminate to acute, base swollen at attachment with receptacle (visible only when fresh), tips puberulent, base variously woolly, otherwise glabrous, 12–14 × 1–2 mm (excluding hyaline margins), deep purplish red becoming greenish tan at base. Ray florets ca. 8, pistillate; corolla yellow, glabrous, lamina oblong-elliptic, apex minutely 3-denticulate, tube 5–7 mm long, lamina 10–12 × 2–4 mm, 4-veined; disk florets 30 to 40, hermaphroditic; corolla yellow, glabrous, tubular, becoming narrowly funnelform at throat, apex of 5 acute lobes, recurved with age; tube 5–6 mm long, throat 4–5 mm long, lobes 1.5–2 mm long, ca. 0.5 mm wide; style branches 1.5–2 mm long; stigmatic surface of undifferentiated cells (entire); apex conical with fringing papillae; anthers ca. 4.5 mm long including appendage, apical appendage lanceolate, base sagittate to rounded, filament collar of unexpanded cells (cylindrical), endothecial cells with thickenings on vertical and transverse walls. Cypsela cylindrical, glabrous, ca. 3 mm long, ca. 1 mm wide, with ca. 10 indistinct ribs; pappus of numerous capillary bristles, in several series, persistent; bristles white, minutely barbellate, 7–11 mm long.

Distribution. *Roldana tlacotepecana* is found in pine-oak and fir forests on rocky slopes at elevations of 2900–3500 m. It has been named after the municipality in Guerrero, Mexico, from which the only known specimens have been collected. Based on these three collections, flowering occurs in January and May.

Affinities. *Roldana tlacotepecana* is part of a group of sparsely pubescent species that may be discoid or radiate. As a group they are centered about the Transmexican Volcanic Belt with some northern and southern extensions.

Roldana tlacotepecana is one of the few small herbaceous species in the genus and appears to be related to *R. metepeca* (B. L. Turner) C. Jeffrey and *R. pinetorum* (Hemsley) H. Robinson & Brettell. Several characters separate them. *Roldana tlacotepecana* has radiate capitula, ovate-orbicular leaf blades with ca. 6 lobes and cordate base, is sparsely lanate-pubescent, and is distributed in the Sierra Madre del Sur. *Roldana metepeca* has discoid capitula, leaf blades that are suborbicular to deltoid in outline with 5 to 7 lobes and a cordate base, and a stipitate-glandular pubescence, and is located in Hidalgo along the Transmexican Volcanic Belt. *Roldana pinetorum* has radiate capitula, centrally peltate orbicular leaf blades, and a stipitate-glandular pubescence, and is distributed along the Sierra Madre del Sur and southward into Central America.

Paratypes. MEXICO. **Guerrero:** Cerro Teotepec, mpio. Tlacotepec, ca. 40 km N of Coyuca de Benítez, 3200–3500 m, 12 May 1963, *Feddema 2918* (MICH); Cerro Teotepec, mpio. Tlacotepec, ca. 17°29′N, 100°12′W, 3400 m, 29 Jan. 1965, *Rzedowski 207* (MICH).

Acknowledgments. I thank Roy Gereau for reviewing the manuscript and preparing the Latin diagnosis. The work benefited from correspondence with Ted Barkley, Billie Turner, and Jose Luis Villaseñor. I also thank the herbarium curators for providing specimen loans.

Literature Cited

Barkley, T. M., B. L. Clark & A. M. Funston. 1996. The segregate genera of *Senecio s.l.* and *Cacalia s.l.* (*Asteraceae: Senecioneae*) in Mexico and Central America. *In* D. J. N. Hind & H. J. Beentje (editors), Compositae: Systematics. Proceedings of the International Compositae Conference, Kew. 1994. (D. J. N. Hind, Editor-in-Chief). Vol. 1: 613–620. Royal Botanic Gardens, Kew.

Funston, A. M. 1999. A Revision of the Genus *Roldana* (Asteraceae: Senecioneae). Unpublished Dissertation, Kansas State University, Manhattan.

Gibson, E. S. 1969. A Revision of the Section *Palmatinervii* of the Genus *Senecio* (Compositae) and its Allies. Unpublished Dissertation, Kansas State University, Manhattan.

Robinson, H. & R. D. Brettell. 1973a. Studies in the Se-

necioneae (Asteraceae). I. A new genus, *Pittocaulon*. Phytologia 26: 451–453.

——— & ———. 1973b. Studies in the Senecioneae (Asteraceae). II. A new genus, *Nelsonianthus*. Phytologia 27: 53–54.

——— & ———. 1973c. Studies in the Senecioneae (Asteraceae). III. The genus *Psacalium*. Phytologia 27: 254–264.

——— & ———. 1974. Studies in the Senecioneae (Asteraceae). V. The genera *Psacaliopsis*, *Barkleyanthus*, *Telanthophora*, and *Roldana*. Phytologia 27: 402–439.

Studies on Mexican Cactaceae. I. *Opuntia pachyrrhiza*, a New Species from the Chihuahuan Desert, Mexico

Héctor M. Hernández, Carlos Gómez-Hinostrosa, and Rolando T. Bárcenas
Departamento de Botánica, Instituto de Biología, UNAM, Apartado Postal 70-233, 04510 México, D.F., México

ABSTRACT. *Opuntia pachyrrhiza*, a new species of Cactaceae from the southeastern portion of the Chihuahuan Desert, Mexico, is described, illustrated, and mapped. The species is easily distinguished from other Mexican *Opuntia* by its relatively short stature, its long, massive rhizome, and by the large, usually poorly branched cladodes. It appears to be restricted to the summits of La Trinidad and El Azul mountain ranges, in northern San Luis Potosí, Mexico.

RESUMEN. Se describe, ilustra y mapea a *Opuntia pachyrrhiza*, una nueva especie de Cactaceae del sureste de la región del Desierto Chihuahuense, México. La especie se distingue fácilmente de otros miembros mexicanos del género por su baja estatura, por su rizoma largo y masivo, y por sus cladodios grandes y pobremente ramificados. Su distribución se restringe aparentemente a las cimas de las Sierras de La Trinidad y El Azul, al norte de San Luis Potosí, México.

Key words: Cactaceae, endemic, Mexico, *Opuntia*, taxonomy.

During the 20th century the Cactaceae attracted the attention of several professional botanists (Nathaniel Britton and Joseph Rose, Franz Buxbaum, Helia Bravo, David Hunt, Wilhelm Barthlott, Edward Anderson, Beat Leuenberger, Nigel Taylor, James Mauseth, and others), who undoubtedly have produced a great deal of scientifically useful information on the family. In addition, due to its popularity among amateurs and private collectors, virtually hundreds of popular books, booklets, and journals on Cactaceae have been produced. The complex variation of the morphological patterns observed in several taxa within the family, in conjunction with the pernicious splitting tendencies and the lack of proper typification, have resulted in an intricate and highly unstable taxonomy. However, despite the fact that the family has been intensively studied, information on most taxa still is scarce and fragmentary. For the last 10 years we have conducted studies on the Cactaceae, primarily from the Chihuahuan Desert Region. As a result of these, we have accumulated a great deal of basic information on many members of the family. This is the first of a series of publications in which we propose to synthesize the available knowledge, published or unpublished, about species of Mexican Cactaceae, primarily on those that are undescribed, little known, or taxonomically confusing.

With an estimated 159 accepted species (Hunt, 1999), *Opuntia* is the largest genus in the Cactaceae and perhaps the most easily recognizable to botanists and amateurs. It has a widespread natural distribution within the American continent, broadly ranging from the Peace River, in northwestern Canada (59°N), south to Patagonia, Argentina (52°S). According to Bravo (1978), Mexico contains the greatest diversity in the genus (117 spp.). The taxonomy of *Opuntia* is extremely unstable, both at the subgeneric and species levels (Britton & Rose, 1919; Bravo, 1978; Benson, 1982). This is due to its complex patterns of morphological variation, to the common occurrence of hybrids and polyploids (e.g., Grant & Grant, 1971; Pinkava et al., 1973; Gibson & Nobel, 1986; Baker & Pinkava, 1987), as well as to the existence of numerous horticultural forms (Nobel, 1994). The genus has been treated in numerous regional floras and taxonomic treatments (e.g., Correll & Johnston, 1970; Benson, 1982; Scheinvar, 1979; Pinkava, 1984; Arias et al., 1997). However, a comprehensive monograph remains to be done for the genus.

As a result of recent distributional studies on the Cactaceae carried out in the southeastern portion of the Chihuahuan Desert Region in Mexico (Gómez-Hinostrosa & Hernández, 2000; Hernández et al., 2001), a distinct, previously undescribed species was discovered.

Opuntia pachyrrhiza H. M. Hernández, C. Gómez-Hinostrosa & R. T. Bárcenas, sp. nov. TYPE: Mexico. San Luis Potosí: Municipio Guadalcázar, Las Lagunas, a 10 km al S de San José de las Flores, 22°43′44″N, 100°23′02″W, alt. 2010 m, 11 Mar. 2000, *H. M. Hernández, C. Gómez-Hinostrosa & R. T. Bárcenas 3312* (holotype, MEXU; isotypes, ASU, ENCB, IEB, MEXU [dry and spirit], MO, K, SLPM). Figure 1.

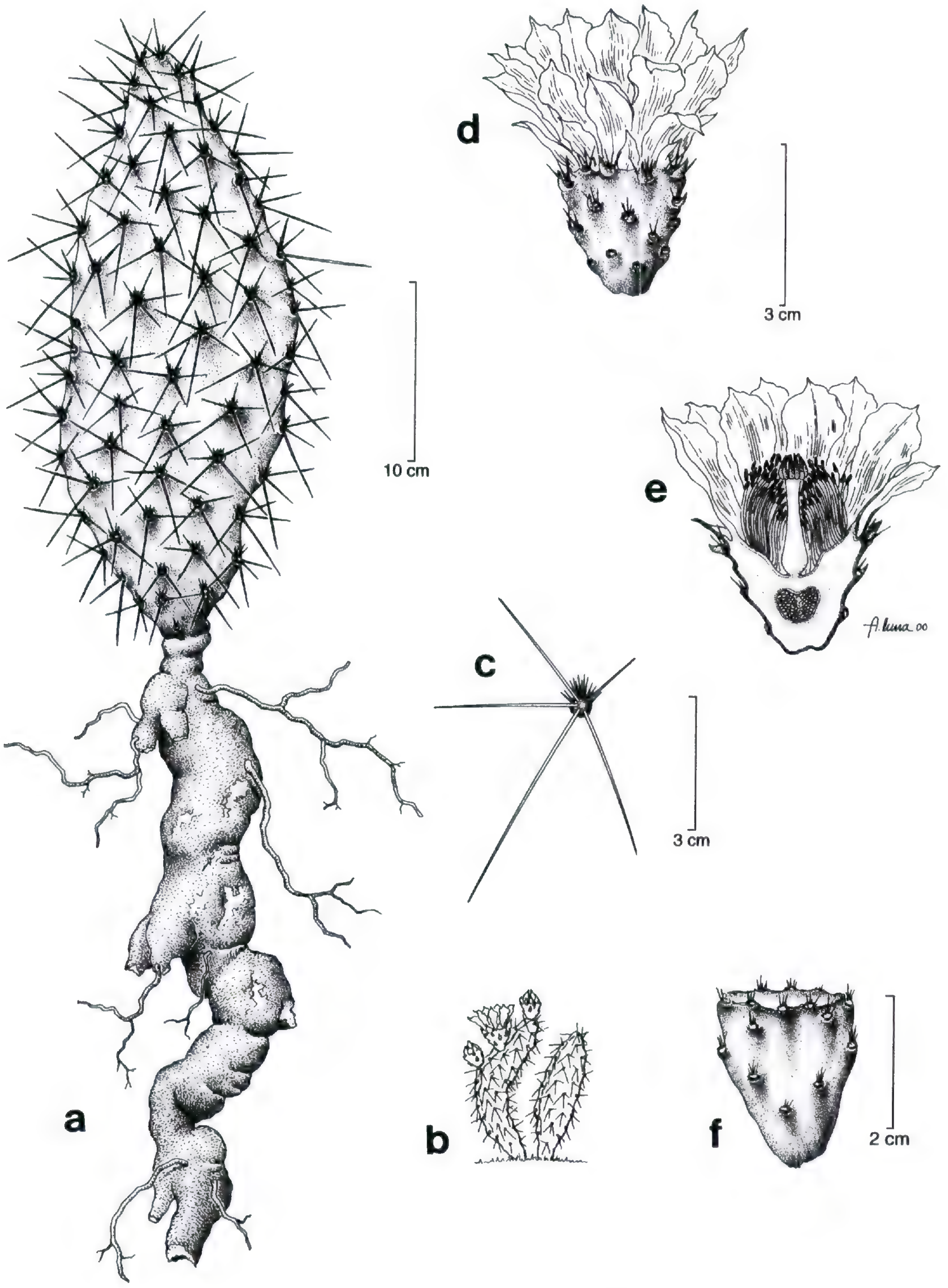


Figure 1. *Opuntia pachyrrhiza* H. M. Hernández, C. Gómez-Hinostrosa & R. T. Bárcenas. —a and b. Habit. —c. Areole. —d and e. Flower. —f. Fruit. a–e, *Hernández et al. 3312* (MEXU); f, *Gómez-Hinostrosa & Martínez 1669* (MEXU).

Planta erecta vel prostrata, caule principali bene definito carens, plerumque vix ramosa, ad 35(–40) cm alta, rhizomate erecto, succulento, tuberiformi, ad 40 cm longo, 12 cm diam. Cladodia plerumque ex rhizomate directe orientia, olivacea, areolis plerumque rubello circumdatis, glabra, elliptica, lanceolata vel obovata, applanata ad valde induplicata, ad 35 cm longa, 16 cm lata. Spinae rigidae, aciculares, 2–9(–13) per areolam, longitudine inaequales, 0.5–4.5(–7) cm longae. Flores campanulati, pericarpello obconico, perianthii segmentis exterioribus viridibus vel flavovirentibus, interioribus aureis. Stigma album, capitatum. Fructus obovoideus, apice truncatus, conspicue umbilicatus.

Plants erect to prostrate, lacking a well-defined main trunk, usually poorly branched, to 35(–40) cm high; rhizome erect, succulent, tuberiform, to 40 cm long, to 12 cm diam. Cladodes usually arising directly from the rhizome, occasionally with smaller secondary or tertiary cladodes, these emerging from the margins or from the faces of the primary cladodes, olive-green, usually reddish around the areoles, glabrous, elliptic, lanceolate or obovate, flat to strongly induplicate, to 35 cm long, 16 cm broad, 5–8 mm thick. Areoles typically 2–4.5 cm apart, with a density of 11–25(–32) areoles per each 100 cm^2, elliptic, 2.5–5(–6) mm diam. in their widest portion, with white wool centrally. Leaves only present on the younger cladodes and on the pericarpel, green to reddish, succulent, conical, ephemeral, 2–4 mm long. Spines light brown when young, becoming dark brown or gray with brown tips with age, rigid, acicular, flattened basally, becoming circular in cross section at the apex, 2–9(–13) per areole, of unequal length, 0.3–0.9 mm diam. at base, 0.5–4.5(–7) cm long. Glochids brown to yellow-ocher, numerous, 1–3(–5) mm long. Flowers usually emerging from the margins or occasionally from the faces of the cladodes, campanulate, 4.5–9 cm long, 4–8 cm diam. at anthesis. Pericarpel olive-green, occasionally slightly tuberculate, obconical, 2–4 cm long, 1.5–2.6 cm diam. at anthesis; areolas with yellow wool; leaves sometimes slightly larger than those of the young cladodes; glochids of unequal length, 0.3–1.5 cm long, reddish brown. External perianth segments green to greenish yellow, the larger ones usually with light green central stripes and yellow edges, reddish at the apex, succulent, becoming membranous inward, oblanceolate to spatulate, truncately attenuate at base, acute to apiculate at apex, margin entire, to 3.5 cm long; internal perianth segments bright yellow, membranous, spatulate, truncately attenuate at base, apiculate at apex, margin entire, to 5 cm long, 1–2.8 cm at the broadest part. Stamens numerous, erect, slightly reclinate toward the pistil; filaments white, sensitive to touch in young flowers, 1.2–1.5 cm long; anthers yellow, dorsifixed, 1.5–2 mm long. Style white, subconical, 2.5–2.8 cm long, 2.2–3.5 mm diam. at base, becoming narrower toward the apex. Stigma white, capitate, 3.5–5 mm diam., with 6 to 10 lobes. Fruit obovoid, truncate at the apex, conspicuously umbilicate, with yellow wool and glochids in the areoles. Seeds light yellow, discoid, to 3.7 mm diam.

Distribution and habitat. The species is restricted to northern San Luis Potosí, Mexico, where it has been collected in several localities at the summit of La Trinidad mountain range (Fig. 2), and from a clearly disjunct population located about 57 km north of this area, in the Municipality of Matehuala (El Azul mountain range; see disjunct population in Fig. 2), between 1635 and 2195 m altitude. Although this species clearly is a narrow endemic, it is relatively abundant in its natural habitat. The areas where *Opuntia pachyrrhiza* occurs are usually covered by highly disturbed grassland and chaparral of *Quercus striatula* Trelease, with *Agave asperrima* Jacobi, *Painteria elachistophylla* (A. Gray ex S. Watson) Britton & Rose, and *Acacia* spp. The soils are relatively deep, dark clay, with limestone outcrops.

Morphology. The habit of *Opuntia pachyrrhiza* is quite variable (Fig. 3A–D). In the wild most individuals only have one to three large cladodes (Fig. 3A–C). However, prostrate plants with several secondary or tertiary cladodes can occasionally be found (Fig. 3D). The shape of the cladodes is also very variable, ranging from elliptic or lanceolate to obovate. The individual cladodes appear to be caducous, as they die when low temperatures and dry conditions are extreme, or when they are damaged by domestic animals or fire. When this happens, the rhizomes have the capability to readily regenerate the lost structures. It is not clear, however, whether this phenomenon occurs on a yearly basis.

As indicated in the description, the flowers are somewhat variable in the size and shape of the segments and pericarpel (Fig. 3E, F). Also, the segments, which are bright yellow with green and reddish tinges, turn orange or pink-orange after anthesis. The fruit is reported to be green when mature, up to 2.7 cm long; however, this report requires confirmation.

Local use. The local people use the highly mucilaginous rhizome of *O. pachyrrhiza* in the preparation of splints for domestic animals (e.g., goats, cows, mules) with broken bones. This practice is thought to reduce the time span for bone healing; however, the effectiveness of this plant in acceler-

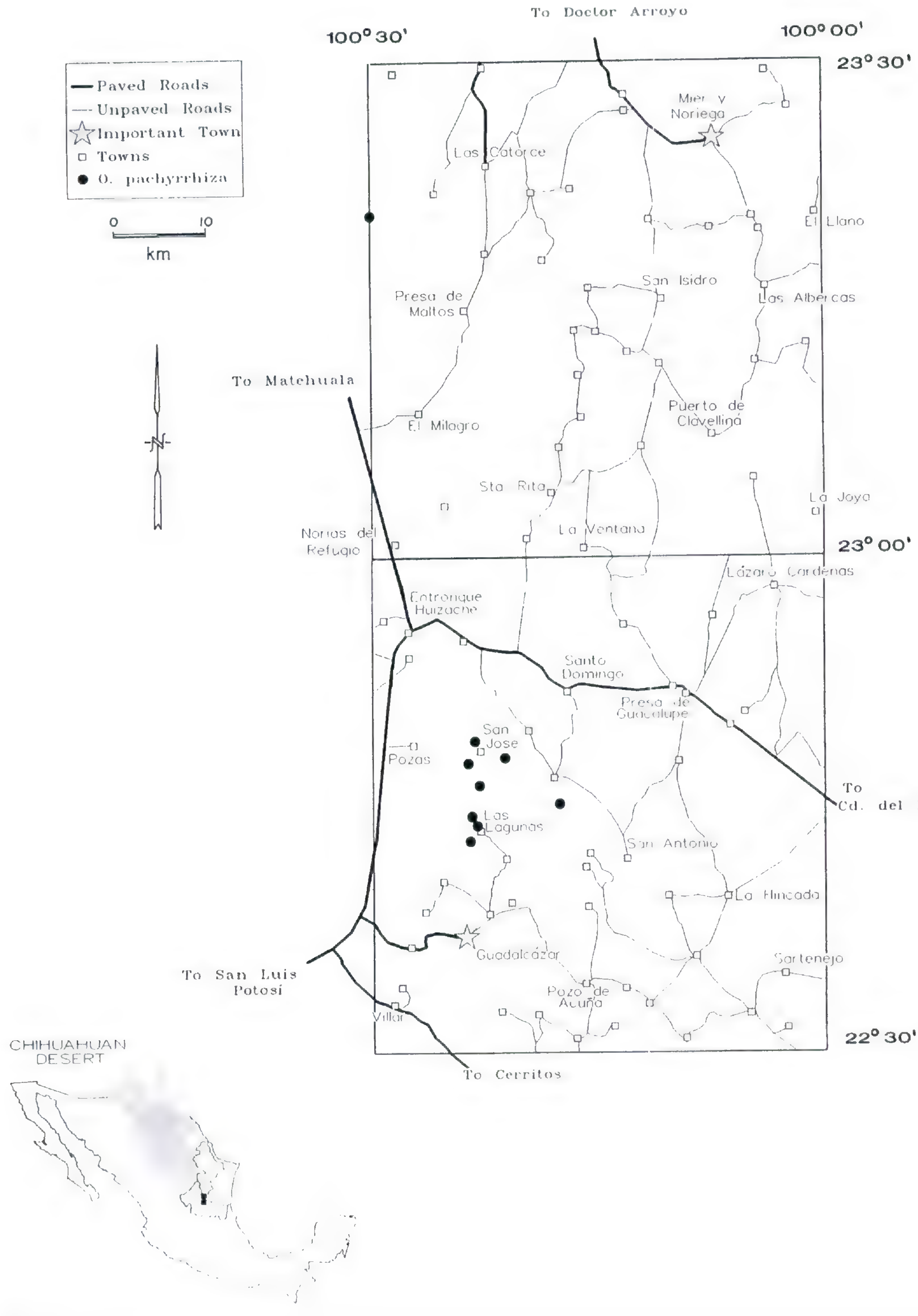


Figure 2. Geographical distribution of *Opuntia pachyrrhiza* (solid dots). Note disjunct population represented by a solid dot on map left boundary.

Figure 3A–D. *Opuntia pachyrrhiza* in natural habitat. —E, F. Flowers of *Opuntia pachyrrhiza*. A, E, and F, from *Hernández et al. 3312*; B–D, from *Hernández et al. 3319*.

ating the restorative process of bones has yet to be confirmed.

Affinities. *Opuntia pachyrrhiza* differs from other species in the genus by its massive rhizome, short stature, poor branching, and by its large, usually elliptic, induplicate, caducous cladodes. However, the taxonomic relationships of this species are unclear. Britton and Rose (1919) included several North American rhizomatous species of *Opuntia* (e.g., *O. allairei* Griffiths, *O. macrorhiza* Engelmann, *O. austrina* Small, *O. megarrhiza* Rose, *O. pottsii* Salm-Dyck, *O. mackensenii* Rose, and *O. chaffeyi* Britton & Rose) in three unrelated groups: series *Tortispinae*, *Setispinae*, and *Chaffeyanae*. Thus, these authors did not confer on the tuberiform condition of the root-like structures a high tax-

onomic value. The same taxonomic viewpoint was adopted by Benson (1982) and Bravo (1978). The taxonomic position of *O. pachyrrhiza* cannot be established until a comprehensive revision of the genus is completed.

Paratypes. MEXICO. **San Luis Potosí:** Mpio. Guadalcázar, Cañada a 8.5 km al S de San José de las Flores, por brecha a Realejo, 22°44′17″N, 100°23′24″W, alt. 1850 m, *C. Gómez-Hinostrosa 1534* (MEXU); 18 km al N de el Realejo, por el camino a San José de las Flores, 22°46′07″N, 100°22′52″W, alt. 2060 m, *H. M. Hernández et al. 3117* (MEXU); Cerros al S-SW de San José de las Flores, 22°47′27″N, 100°23′37″W, alt. 2195 m, *H. M. Hernández et al. 3126* (MEXU); ca. 5 km de San José de las Flores, por el camino a Los Amoles, 22°47′47″N, 100°21′11″W, alt. 1915 m, *H. M. Hernández et al. 3264* (MEXU); a 2 km al NW de San José de las Flores, sobre el camino a El Tunalillo, 22°48′N, 100°23′W, alt. 2085 m, *H. M. Hernández et al. 3314* (MEXU); Las Lagunas, 22°43′44″N, 100°32′02″W, alt. 2010 m, *H. M. Hernández et al. 3319* (MEXU); ca. 7 km al N de La Yerbabuena, 22°45′01″N, 100°17′31″W, alt. 1635 m, *R. T. Bárcenas & C. Gómez-Hinostrosa 1291* (MEXU); Mpio. Matehuala, Sierra El Azul, ca. 7 km al NE de San Miguel, 23°20′38″N, 100°29′59″W, alt. 2055 m, *C. Gómez-Hinostrosa & S. Martínez 1669* (MEXU).

Acknowledgments. The authors thank Mario Torres, from San José de las Flores, and Pablo Hernández for assisting us in the field. We also thank Albino Luna for the botanical illustration, and Samuel Aguilar for helping us in the preparation of Figure 3. We are especially indebted to Fernando Chiang for reviewing the manuscript and for the Latin diagnosis. This project was conducted under SEMARNAP collecting permit FLOR-0004.

Literature Cited

Arias, S., S. Gama & U. Guzmán. 1997. Cactaceae A. L. Juss. Flora del Valle de Tehuacán-Cuicatlán. 14. Instituto de Biología, UNAM, México.

Baker, M. & D. Pinkava. 1987. A cytological and morphometric analysis of a triploid apomict, *Opuntia ×kelvinensis* (subgenus *Cylindropuntia*, Cactaceae). Brittonia 39: 387–401.

Benson, L. 1982. The Cacti of the United States and Canada. Stanford Univ. Press, Stanford.

Bravo, H. 1978. Las Cactáceas de México. Vol. I. Universidad Nacional Autónoma de México, México.

Britton, N. L. & J. N. Rose. 1919. The Cactaceae. Vol. I. Carnegie Institution of Washington, Washington, D.C.

Correll, D. & M. Johnston. 1970. Manual of the Vascular Plants of Texas. Univ. of Texas, Austin.

Gibson, A. & P. Nobel. 1986. The Cactus Primer. Harvard Univ. Press, Cambridge, Massachusetts.

Gómez-Hinostrosa, C. & H. M. Hernández. 2000. Diversity, geographical distribution, and conservation of Cactaceae in the Mier y Noriega region, Mexico. Biodiversity and Conservation 9: 403–418.

Grant, V. & K. A. Grant. 1971. Natural hybridization between the cholla cactus species *Opuntia spinossior* and *Opuntia versicolor.* Proc. Natl. Acad. Sci., U.S.A. 68: 1993–1995.

Hernández, H. M., C. Gómez-Hinostrosa & R. T. Bárcenas. 2001. Diversity, spatial arrangement, and endemism of Cactaceae in the Huizache area, a hot-spot in the Chihuahuan Desert. Biodiversity and Conservation 10: 1097–1112.

Hunt, D. 1999. CITES Cactaceae Checklist. Royal Botanic Gardens, Kew/ International Organization of Succulent Plant Study, England.

Nobel, P. 1994. Remarkable Agaves and Cacti. Oxford Univ. Press, New York.

Pinkava, D. 1984. Vegetation and flora of the Bolsón of Cuatro Ciénegas region, Coahuila, Mexico: Summary, endemism and corrected catalogue. J. Arizona-Nevada Acad. Sci. 19: 23–47.

———, M. McLeod, L. McGill & R. Brown. 1973. Chromosome numbers in some cacti of western North America. II. Brittonia 25: 2–9.

Scheinvar, L. 1979. Cactaceae. Pp. 93–135 *in*: J. Rzedowski & G. C. de Rzedowski (editors), Flora Fanerogámica del Valle de México, Vol. 2. Instituto de Ecología, A.C., México.

Paeonia anomala subsp. *veitchii* (Paeoniaceae), a New Combination

Hong Deyuan and Pan Kaiyu
Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Chinese Academy of Sciences, Xiangshan, Beijing, 100093, People's Republic of China

Nicholas J. Turland
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. A study of morphological characters of *Paeonia veitchii* Lynch, based on over 180 specimens, reveals that the following new combination is necessary: *P. anomala* L. subsp. *veitchii* (Lynch) D. Y. Hong & K. Y. Pan, comb. et stat. nov. The name is also lectotypified. Three previously recognized varieties of *P. veitchii* are here reduced to synonymy for the first time: *P. veitchii* var. *leiocarpa* W. T. Wang & S. H. Wang ex K. Y. Pan, *P. veitchii* var. *uniflora* K. Y. Pan, and *P. woodwardii* Stern & Cox.

Key words: China, *Paeonia,* Paeoniaceae.

Paeonia veitchii Lynch, endemic to China (Gansu, Ningxia, Qinghai, Shaanxi, Shanxi, Sichuan, and Xizang), has been treated as an independent species since its original description in 1909 (Lynch, 1909; Stern, 1946; Fang, 1958; Anonymous, 1972; Pan, 1979). It is a variable entity in flower number per stem and leaf and carpel indumentum, and was treated as four varieties by Pan (1979). Stern (1946) stated that it is closely allied to the allopatric *P. anomala* L. from China (Xinjiang), Kazakstan, Mongolia, and Russia.

Paeonia veitchii differs from *P. anomala,* according to Stern (1946) and Pan (1979), in having several flowers on a stem instead of a solitary flower as in *P. anomala.* We examined some 175 specimens of *P. veitchii* and observed that the number of flowers on a stem varies greatly. At one extreme, there can be four fully developed flowers per stem. The majority of individuals of *P. veitchii* possess one to three flowers or underdeveloped flower buds per stem in addition to the terminal, fully developed flower. At the other extreme, only a solitary, terminal flower is fully developed without additional flower buds, the condition seen in the majority of individuals of *P. anomala.* Rarely in *P. anomala* may there be one or two underdeveloped flower buds in the upper leaf axils. In such cases, both conditions, i.e., with or without additional underdeveloped flower buds, may be observed within a single population of *P. anomala. Paeonia veitchii* is evidently different from *P. anomala* in the number of flowers per stem, but this character is continuously variable and bridges the two taxa.

There is also sometimes a difference in leaf indumentum. The adaxial leaf surface is hispid or hirsute along the veins in both *Paeonia anomala* and *P. veitchii.* The abaxial leaf surface is glabrous in *P. anomala* (at least in all the specimens examined for this study) and is also usually glabrous in *P. veitchii,* but in some individuals of *P. veitchii* the veins may be hispid or hirsute. For example, we examined 40 specimens of *P. veitchii* from populations in southern Gansu and found some plants with leaves hispid or hirsute along the veins abaxially, but more often with leaves glabrous abaxially. Among these same specimens, we also found that both character states occurred within the same population.

Both *Paeonia anomala* and *P. veitchii* are variable in carpel indumentum. Both species usually have hispid or hirsute carpels, rarely glabrous ones, and both species may exhibit the two character states within the same population. We therefore regard carpel indumentum as a character of little or no taxonomic value.

The two taxa are allopatrically distributed, with *Paeonia anomala* to the north and northwest of the Gobi Desert and *P. veitchii* to the south. On the basis of this disjunct distribution, one might argue in favor of separation at specific rank. However, the morphological differences between the two taxa are not clear cut, showing considerable intergrading especially in flower number per stem. Therefore, subspecific rank seems more appropriate. The diagnostic features of the two subspecies are summarized in Table 1.

Four varieties, in addition to the typical variety, have been recognized by various authors under

Table 1. Morphological comparison of the subspecies in *Paeonia anomala*.

Paeonia anomala	Subsp. *anomala*	Subsp. *veitchii*
Abaxial leaf surface	Glabrous	Usually glabrous, rarely hispid or hirsute along veins
Adaxial leaf surface	Hispid or hirsute along veins	Hispid or hirsute along veins
Fully developed flowers per stem	1	2 to 4, rarely 1
Additional underdeveloped flower buds per stem	Usually absent, rarely 1 or 2	Usually 1 to 3, rarely absent
Total flowers and buds per stem	Usually 1, rarely 2 or 3	Usually 2 to 4, rarely 1
Carpels	Hispid or hirsute, rarely glabrous	Hispid or hirsute, rarely glabrous
Distribution	China (N Xinjiang), NE Kazakstan, N Mongolia, Russia (NE European part, Siberia)	China (C & S Gansu, S Ningxia, E Qinghai, S Shaanxi, N Shanxi, W Sichuan, E Xizang)

Paeonia veitchii, two of them originally described at specific rank. They are discussed below. We do not consider formal taxonomic recognition to be appropriate for any of the four, and accordingly reduce them to synonymy under *P. anomala* subsp. *veitchii*.

First, we could find no significant differences between *Paeonia beresowskii* Komarov and *P. veitchii*. After studying the protologue (Komarov, 1921: 5–6) and the specimens from the type locality (Songpan County in Sichuan), we follow Stern (1946) and Fang (1958) in reducing it to the synonymy in *P. veitchii*.

Paeonia woodwardii, according to its protologue (Stern & Cox, 1930: 43), differs from *P. veitchii* in its smaller stature (ca. 30 cm tall, vs. up to 90 cm in *P. veitchii*) and longer, hispid hairs along the veins on both leaf surfaces. Stern (1946), followed by Fang (1958), recognized *P. woodwardii* as a variety under *P. veitchii*. However, as earlier mentioned, *P. veitchii* is variable in its leaf indumentum, usually having hairs only adaxially, but rarely also abaxially. We examined specimens from southern Gansu, including the type locality (Jone in Gansu) of *P. woodwardii*, and found both states of leaf indumentum. Therefore, we regard *P. woodwardii* as merely representing part of the specific variation found within *P. veitchii* and do not formally recognize it.

Paeonia veitchii var. *leiocarpa* W. T. Wang & S. H. Wang ex K. Y. Pan was distinguished in its protologue (Pan, 1979: 603) from typical *P. veitchii* only by its glabrous carpels. The majority of specimens examined by us from the type locality (Jinchuan County in Sichuan) have hispid carpels. Otherwise, those plants with glabrous carpels and those with hispid carpels generally resemble each other. As earlier mentioned, we attach little or no taxonomic value to carpel indumentum and therefore regard variety *leiocarpa* as a synonym of *P. veitchii*.

Regarding *Paeonia veitchii* var. *uniflora* K. Y. Pan, as earlier mentioned, individuals possessing a single flower on a stem, without additional underdeveloped flower buds, belong only to one extreme of a continuum of variation in flower number per stem. We therefore also reduce this variety to the synonymy of *P. veitchii*.

The name *Paeonia veitchii* var. *purpurea* Schipczinsky is invalid under Article 26.2 of the *Saint Louis Code* (Greuter et al., 2000) because it included the nomenclaturally typical element of *P. veitchii*. Schipczinsky's protologue (1921: 46) gave two varieties under the species name: variety "α." *purpurea* and variety "β." *beresowskii* (Komarov) Schipczinsky. For six other species in the same paper, Schipczinsky used "var. α. *typica*" (or "*tipica*" or "*genuina*") to indicate the nomenclaturally typical element; such names are also invalid under Article 24.3.

Regarding the actual type of *Paeonia veitchii*, Lynch's protologue (1909: 2) stated, "It is a native of the uplands around Tatien-lu [Kangding in Sichuan], a district in the far west of China, close to the Tibetan frontier, and is frequently found by the margins of thickets at an elevation of from 8,000 to 11,000 feet. It was introduced by Messrs. James Veitch & Sons through their collector, Mr. Wilson." There are two specimens at K labeled as Wilson collections for James Veitch & Sons from "Western China" at "8–10,000 ft.": *E. H. Wilson 3034* and *E. H. Wilson 3036*. These specimens are clearly part of the original material for *P. veitchii* and, in the absence of any other explicitly cited specimens in the protologue, either is eligible as the lectotype (Article 9.10). Number 3034 is the better of the two specimens, with a flower and a

fruiting head. The formal lectotype designation is made below.

Paeonia anomala subsp. **veitchii** (Lynch) D. Y. Hong & K. Y. Pan, comb. et stat. nov. Basionym: *Paeonia veitchii* Lynch, Gard. Chron, ser. 3, 46: 2, fig. 1. 1909. *Paeonia veitchii* var. *purpurea* Schipczinsky, Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 2: 46. 1921, nom. inval. TYPE: China. Sichuan: "Tatien-lu" [from protologue, i.e., Kangding], "8–10,000 ft." [from specimen], s.d., *E. H. Wilson (for James Veitch & Sons) 3034* (lectotype, selected here, K; isolectotype, PE).

Paeonia beresowskii Komarov, Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 2: 5. 15 Jan. 1921. *Paeonia veitchii* var. *beresowskii* (Komarov) Schipczinsky, Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 2: 46. 26 Mar. 1921. TYPE: China. Sichuan: "Sun-Pan-tin [Songpan County], circa p. Gui-chua," 9 June 1894, *M. Beresowski s.n.* (holotype, LE not seen).

Paeonia woodwardii Stern & Cox, in Cox, Pl. Introd. Farrer, 43. 1930. Syn. nov. *Paeonia veitchii* var. *woodwardii* (Stern & Cox) Stern, J. Roy. Hort. Soc. 68: 130. 1943. TYPE: China. Gansu: "Chuoni" [from protologue, i.e., Jone], "alps among rocks above above Satanee 7–8000 [ft.]" [from specimen], 15 May 1914, *R. Farrer 67* (holotype, E).

Paeonia veitchii var. *leiocarpa* W. T. Wang & S. H. Wang ex K. Y. Pan, Fl. Reipubl. Popularis Sin. 27: 603. 1979. Syn. nov. TYPE: China. Sichuan: Jinchuan County, Kasa Township, Yinchanggou, forest by stream, 2700 m, 26 Apr. 1958, *X. Li 77248* (holotype, PE).

Paeonia veitchii var. *uniflora* K. Y. Pan, Fl. Reipubl. Popularis Sin. 27: 603. 1979. Syn. nov. TYPE: China. Sichuan: Garzê County, Xiongjiling, 3600 m, mountain summit, bushes, 18 June 1974, *Qinghai-Xizang Expedition Vegetation Group 34* (holotype, PE).

Herbs perennial, 30–90 cm tall. Roots cylindric, thick, 1–2 cm diam., attenuate downward. Stem glabrous. Leaves biternate, sometimes leaflets decurrent at base; leaflets several times segmented; ultimate segments (37–)50–100(–180), dark green, linear or linear-lanceolate, 0.25–2 cm, abaxially usually glabrous, rarely hispid or hirsute along veins, adaxially hispid or hirsute along veins, apex acuminate. Flowers 1 to 4 per stem, terminal and axillary, 4.5–10 cm diam.; lateral flowers sometimes with a leaf below; bracts 2 or 3, leaflike, lanceolate, unequal, margin lobed or entire; 1 or 2 underdeveloped flower buds often also present in axils of distal leaves. Sepals 3 to 5, broadly ovate, 1.5–1.7 × 1–1.4 cm, apex usually caudate. Petals 6 to 9, purple-red, red, or pink, rarely nearly white, obovate, 2.5–4 × 1.5–3 cm, apex notched or entire. Filaments purple, 5–10 mm. Disc fleshy, enveloping only base of carpels. Carpels (1 or)2 or 3(to 5), hispid or hirsute, very rarely glabrous. Follicles ovoid-cylindric, 1–2.7 × 1–1.5 cm, hispid or hirsute. Seeds black, glossy, oblong-globose, ca. 6 × 5.5 mm.

Phenology. Flowering from late April to June in Sichuan, and from early June to the middle of July in Gansu and Qinghai. Fruits mature from August to early September.

Habitat. Relatively moist habitats: forests, grasslands at forest margins, scrub, or subalpine and alpine meadows with shrubs, from 1800 to 3900 m.

Distribution. Endemic to China, with a wide distribution: central and southern Gansu, southern Ningxia (Liupan Shan), eastern Qinghai, southern Shaanxi (Qin Ling), northern Shanxi (Wutai Shan), western Sichuan, and extreme eastern Xizang.

Additional specimens examined:

Paeonia anomala subsp. *anomala.* CHINA. **Xinjiang:** *T. H. Ying 1006* (PE), *T. H. Ying 1007* (PE), *T. H. Ying 1009* (PE), *T. H. Ying 1010* (PE), *T. H. Ying 1011* (PE), *T. H. Ying 1014* (PE), *T. H. Ying 1022* (PE).

Paeonia anomala subsp. *veitchii.* CHINA. **Gansu:** *Anonymous s.n.* (CPB), *Anonymous s.n.* (NWTC), *Anonymous s.n.* (NWTC), *Anonymous s.n* (PE), *Anonymous 84* (NWTC), *Anonymous 557* (PE), *J. L. Bai 8613* (NWTC), *Chen & Ju s.n.* (NWTC), *T. K. Fu 834* (PE), *Gansu Herbs Group s.n.* (NWTC), *K. S. Hao 604* (PE), *Y. Q. He 4516* (PE), *Y. Q. He 4915* (PE), *W. Y. Hsia 5707* (PE), *Huanghe Expedition 1689* (PE), *Huanghe Expedition 3183* (PE), *Huanghe Expedition 4655* (PE), *Huanghe Expedition 4735* (PE), *Jiang & Jin 386* (PE), *Lian & Chen 31* (NWTC), *Lian & Chen 72* (NWTC), *Lian, Wang et al. 79197* (NWTC), *X. F. Long 85* (NWTC), *J. F. Rock 12260* (PE), *J. F. Rock 12829* (PE), *J. F. Rock 13127* (PE), *South Gansu Grassland Expedition 681* (NWTC), *Taohe Expedition 3243* (PE), *J. Q. Wang 197* (NWTC), *Q. R. Wang 1869* (NWTC), *Q. R. Wang 7034* (NWTC), *Q. R. Wang 7270* (NWTC), *T. P. Wang 4594* (PE), *T. P. Wang 5343* (PE), *T. P. Wang 6944* (PE), *T. P. Wang 15240* (PE), *M. S. Yan 1843* (NWTC), *H. J. Zhou 708* (NWTC), *G. L. Zhu 80006* (NWTC), *G. L. Zhu 80077* (NWTC). **Ningxia:** *Y. W. Cui 10281* (PE), *Gansu First Team of Huanghe Expedition 2168* (PE), *K. M. Liou 5659* (PE). **Qinghai:** *Gansu-Qinghai Expedition 2493* (PE), *B. Z. Guo 6767* (HNWP), *B. Z. Guo 7010* (HNWP), *B. Z. Guo 7396* (HNWP), *B. Z. Guo 10186* (HNWP), *B. Z. Guo 10232* (HNWP), *Guo & He 9012* (HNWP), *Guo & Wang 6008* (HNWP), *Guo & Wang 6717* (HNWP), *Guo & Wang 25058* (HNWP), *Guo & Yang 9608* (HNWP), *K. S. Hao 779* (PE), *K. C. Kuan 77309* (PE), *Liang, Fan, Li et al. 378* (HNWP), *K. M. Liou 5970* (PE), *K. M. Liou 6019* (PE), *K. M. Liou 6044* (PE), *K. M. Liou 6178* (PE), *S. W. Liu 2115* (HNWP), *Liu & Luo 1040* (HNWP), *Z. Y. Qing 1218* (HNWP, PE), *P. C. Tsoong 8842* (PE), *S. X. Wang 1065* (HNWP), *W. Y. Wang 26771* (HNWP), *W. Y. Wang 26818* (HNWP), *W. Y. Wang 27060* (HNWP), *W. Y. Wang et al. 27347* (HNWP), *Wang & Zhou 19* (HNWP), *Wang & Zhou 198A* (HNWP), *Yu, Lu, Gu & Li 68* (PE), *G. Z. Zhang 5* (HNWP), *Z. H. Zhang et al. 97* (HNWP), *Z. H. Zhang et al. 414* (HNWP), *Z. H. Zhang et al. 4291* (HNWP), *Z. H. Zhang et al.*

4317 (HNWP), *Z. H. Zhang et al. 4320* (HNWP), *Zhang & Li 502* (HNWP), *S. X. Zhen 351* (PE), *L. H. Zhou 2528* (HNWP). **Shaanxi:** *K. J. Fu 4441* (PE), *Hong & Zhu PB85065* (PE), *W. Y. Hsia 4539* (PE), *W. Y. Hsia 4571* (PE), *Pharmaceutical Expedition 2019* (PE). **Shanxi:** *P. Licent 2022* (PE), *Shanxi Expedition 684* (PE), *Shanxi Expedition, Wang & Tian 594* (PE), *T. Tang 938* (PE). **Sichuan:** *Y. W. Cui 4348* (PE), *W. P. Fang 4213* (PE), *W. P. Fang 6037* (PE), *Z. He 12339* (PE), *He & Zhou 13338* (PE), *Hong, Luo & He H95034* (PE), *Hong & Zhong PB82105* (PE), *Hong & Zhu PB85019* (PE), *Hong & Zhu PB85040* (PE), *W. G. Hu 13050* (PE), *Hu & He 10088* (PE), *Hu & He 10373* (PE), *Hu & He 10463* (PE), *Hu & He 11173* (PE), *Huang, Luo & Jiang 730* (PE), *S. X. Jia 229* (PE), *S. Jiang 5768* (PE), *S. Jiang 8874* (PE), *S. Jiang 8930* (PE), *S. Jiang 8965* (PE), *S. Jiang 9082* (PE), *S. Jiang A-7162* (PE), *S. Jiang A-7275* (PE), *X. C. Jiang 36014* (PE), *X. C. Jiang 36433* (PE), *Jiang & Jin 2113* (PE), *Jiang & Xiong 34242* (PE), *Jiang & Xiong 34319* (PE), *Jiang & Xiong 35625* (PE), *P. X. Li 10100* (PE), *P. X. Li 10137* (PE), *P. X. Li 10143* (PE), *X. Li 70247* (PE), *X. Li 70441* (PE), *X. Li 70510* (PE), *X. Li 70685* (PE), *X. Li 70719* (PE), *X. Li 70867* (PE), *X. Li 70903* (PE), *X. Li 71029* (PE), *X. Li 71087* (PE), *X. Li 71196* (PE), *X. Li 71645* (PE), *X. Li 74842* (PE), *X. Li 74936* (PE), *Nanshui-Beidiao Expedition 2912* (PE), *Z. X. Qu 2792* (PE), *Sichuan-Econom. A59–1001* (PE), *Sichuan-Econom. A59–1208* (PE), *Sichuan-Econom. A59–2290* (PE), *Sichuan-Econom. A59–246* (PE), *Sichuan-Econom. A59–2554* (PE), *Sichuan-Econom. Ya-838* (PE), *Sichuan Plants Collection 905* (PE), *H. Smith 2499* (PE), *Z. P. Song 38544* (PE), *Z. P. Song 39107* (PE), *P. C. Tsoong 5004* (PE), *P. C. Tsoong 5024* (PE), *T. H. Tu 362* (PE), *T. H. Tu 4329* (PE), *F. T. Wang 22930* (PE), *West Sichuan Expedition, Kuan, Wang et al. 243* (PE), *West Sichuan Expedition, Kuan, Wang et al. 352* (PE), *West Sichuan Expedition, Kuan, Wang et al. 732* (PE), *J. S. Ying 3113* (PE), *J. S. Ying 3869* (PE), *J. S. Ying 4582* (PE), *J. S. Ying 4591*(PE), *T. T. Yü 2200* (PE), *T. T. Yü 6137* (PE), *Zhang & Lang 57* (PE), *Zhang & Ren 5572* (PE), *Zhang & Ren 6082* (PE), *Zhang & Ren 6322* (PE), *Zhang & Zhou 22092* (PE), *Zhang & Zhou 22155* (PE), *Zhang & Zhou 22675* (PE), *Zhang & Zhou 23742* (PE), *S. F. Zhu 20491* (PE). **Xizang [Tibet]:** *Qinghai-Xizang Expedition Vegetation Group 9893* (PE).

Acknowledgments. Our sincere gratitude is due to Peter H. Raven, Director of the Missouri Botanical Garden, for his continuous encouragement and help in our study on *Paeonia*. We also thank Li Qiaoling for typing the original manuscript, Sylvia M. Phillips and Mark F. Watson for checking type material at K and E, respectively, Michael G. Gilbert for checking literature at BM, the directors and curators of the herbaria CPB, E, HNWP, K, NWTC, and PE for allowing access to their collections, and Victoria C. Hollowell, editor of *Novon*, and two anonymous reviewers for their valuable suggestions on earlier versions of the manuscript.

Literature Cited

Anonymous. 1972. *Paeonia veitchii* Lynch. P. 654, fig. 1307 *in:* Iconographia Cormophytorum Sinicorum, 1. Science Press, Beijing.

Fang, W. P. 1958. Notes on Chinese paeonies. Acta Phytotax. Sin. 7: 297–323, pl. 61–63.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Komarov, V. L. 1921. Plantae novae chinenses. Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 2: 5–8.

Lynch R. I. 1909. New or noteworthy plants. *Paeonia veitchii* n. sp. Gard. Chron., ser. 3, 46: 2, fig. 1.

Pan, K. Y. 1979. *Paeonia* L. Pp. 37–59 *in:* Flora Reipublicae Popularis Sinicae, 27. Science Press, Beijing.

Schipczinsky, N. V. 1921. Kratkiy obzor roda *Paeonia* (Tourn.) L. Bot. Mater. Gerb. Glavn. Bot. Sada RSFSR 2: 41–47.

Stern, F. C. 1946. A Study of the genus *Paeonia*. Royal Horticultural Society, London.

———— & E. H. M. Cox. 1930. The Farrer-Purdom expedition to Kansu 1914–1915. Pp. 25–53 *in* E. H. M. Cox (editor), The Plant Introductions of Reginald Farrer. New Flora and Silva, London.

New Combinations in *Phemeranthus* Rafinesque (Portulacaceae)

Robert W. Kiger

Hunt Institute for Botanical Documentation, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213, U.S.A.

Abstract. New combinations are made to transfer 13 species from *Talinum* Adanson to *Phemeranthus* Rafinesque, which will be recognized separately in the treatment of Portulacaceae being prepared for the *Flora of North America* (FNA). The new combinations are: *Phemeranthus aurantiacus* (Engelmann) Kiger, *P. brevicaulis* (S. Watson) Kiger, *P. calcaricus* (S. Ware) Kiger, *P. calycinus* (Engelmann) Kiger, *P. humilis* (Greene) Kiger, *P. longipes* (Wooton & Standley) Kiger, *P. marginatus* (Greene) Kiger, *P. mengesii* (W. Wolf) Kiger, *P. parviflorus* (Nuttall) Kiger, *P. rugospermus* (Holzinger) Kiger, *P. sediformis* (von Poellnitz) Kiger, *P. thomsonii* (N. D. Atwood & S. L. Welsh) Kiger, and *P. validulus* (Greene) Kiger.

Key words: North America, *Phemeranthus*, Portulacaceae, *Talinum*.

Rafinesque (1814: vol. 1, p. 86) described the segregate genus *Phemeranthus*, comprising only *P. teretifolius* (Pursh) Rafinesque from southeastern North America, transferred from *Talinum* Adanson. Since then, other authors have continued to recognize that species in *Talinum*, within section *Phemeranthus* (Rafinesque) DC., along with a number of similar ones described subsequently, also restricted to New World locales. However, a fairly strongly correlated set of differences in the leaf, pollen, fruit, and seed structures of these species compared with those of section *Talinum* (Carolin, 1987, 1993; Hershkovitz, 1993) supports their segregation at the generic level. *Phemeranthus* has leaf blades ca. 1–3 mm wide and terete or semi-terete, or (only in *P. aurantiacus*) 10–20 mm wide and narrowly linear; pollen polyrugate; capsules dehiscent at maturity with the valves falling away promptly, the epicarp and endocarp not appreciably differentiated and not separating from each other; and seeds smooth or distinctly ridged, not tuberculate overall, mostly with a covering pellicle (sometimes called an "investing aril"). *Talinum* has leaf blades greater than 1 cm wide and broadly planate; pollen polyforate; capsules tardily dehiscent with the valves or portions of them persistent, the epicarp and endocarp differentiated and often separating from each other; and seeds minutely tuberculate overall, not ridged, with a small, basal aril. Recent molecular data from nrDNA (ITS1, ITS2) and cpDNA (*ndh*F) sequences (Hershkovitz & Zimmer, 1997, 2000; Applequist & Wallace, 2001) are congruent with the morphological evidence and indicate that *Phemeranthus* is phylogenetically distinct from the otherwise mainly Old World *Talinum*, which retains ca. 15 species, only two of which, *T. paniculatum* (Jacquin) Gaertner and *T. triangulare* (Jacquin) Willdenow, are found in North America (and also in the Caribbean, Central and South America, and Africa).

Phemeranthus aurantiacus (Engelmann) Kiger, comb. nov. Basionym: *Talinum aurantiacum* Engelmann, Boston J. Nat. Hist. 6: 153. 1850. TYPE: U.S.A. Texas: 1847, *F. Lindheimer 579* (lectotype, selected here, GH [fruit and late flower, printed label date "1847–48," on sheet with *F. Lindheimer 235*]; possible isolectotypes or syntypes, GH [anthesis, no fruit, ex Boston Soc. Nat. Hist., ex J. A. Lowell Herb., printed label date "1847"], K, LE, US).

For typifying species described by Engelmann and by Gray based on Lindheimer's widely distributed Texas exsiccatae, the set of specimens at GH, on which their descriptions were based, is therefore the most important. The numbers on the labels of Lindheimer's specimens are actually distribution numbers, rather than individual collection numbers, and the specimens under a given number often are from different collections made at various times and places. This is clearly the case with *Lindheimer 579*, and thus neither of the GH specimens can be considered a holotype in the proper sense. Engelmann's original description of *Talinum aurantiacum* includes both flower and fruit characters, so of the two GH sheets, neither heretofore marked as a type, the one that exhibits both flower and fruit characters, and has been in the Gray Herbarium all along, is the obvious choice for lectotype. It agrees in all particulars with Engelmann's rather terse description.

Phemeranthus brevicaulis (S. Watson) Kiger, comb. nov. Basionym: *Talinum brevicaule* S. Watson, Proc. Amer. Acad. Arts 21: 446. 1886. TYPE: Mexico. Chihuahua: Santa Eulalia Mountains, 20 May 1885, *C. G. Pringle 26* (holotype, GH; isotype, US).

Phemeranthus calcaricus (S. Ware) Kiger, comb. nov. Basionym: *Talinum calcaricum* S. Ware, Rhodora 69: 466. 1967. TYPE: U.S.A. Tennessee: Davidson County, SW of Nashville on US Route 70S across road from Mountain View School, 21 Aug. 1966, *S. Ware 215* (holotype, US; isotypes, C, SMS not seen, UT not seen, VDB not seen).

Phemeranthus calycinus (Engelmann) Kiger, comb. nov. Basionym: *Talinum calycinum* Engelmann, in F. A. Wislizenus, Mem. Tour N. Mexico, 88. 1848. *Claytonia calycina* (Engelmann) Kuntze, Revis. Gen. Pl. 1: 57. 1891. TYPE: U.S.A. Kansas or Oklahoma: Cimmaron River, June 1846, *F. A. Wislizenus s.n.* (holotype, MO).

Phemeranthus humilis (Greene) Kiger, comb. nov. Basionym: *Talinum humile* Greene, Bot. Gaz. 6: 183. 1881. TYPE: U.S.A. New Mexico: Grant County, Pinos Altos Mountains, mesa at southern base of Twin Peak, 11 Aug. 1880, *E. L. Greene 217* (holotype, presumably NDG not seen; isotypes, GH, K).

Since the type collection was made by Greene himself, the holotype should be in his own herbarium (NDG), but I have not yet had an opportunity to look for it there.

Phemeranthus longipes (Wooton & Standley) Kiger, comb. nov. Basionym: *Talinum longipes* Wooton & Standley, Contr. U.S. Natl. Herb. 16: 120. 1913. TYPE: U.S.A. New Mexico: Dona Ana County, Tortugas Mountain, 27 Aug. 1894, *E. O. Wooton s.n.* (holotype, US).

Phemeranthus marginatus (Greene) Kiger, comb. nov. Basionym: *Talinum marginatum* Greene, Leafl. Bot. Observ. Crit. 2: 270. 1912. TYPE: Mexico. Nayarit: Sierra Madre near Santa Teresa, Tepic, 12 Aug. 1897, *J. N. Rose 2221* (holotype, US).

Phemeranthus mengesii (W. Wolf) Kiger, comb. nov. Basionym: *Talinum mengesii* W. Wolf, Amer. Midl. Naturalist 6: 153. 1920. TYPE: U.S.A. Alabama: Cullman County, Little River, n.d., *W. Wolf 1668* (holotype, SB transferred to AUA not seen).

Wolf's original description of *Talinum mengesii* matches unproblematically with plants from the southeastern U.S. that are consistently distinguishable from other species of the genus by the combination of sepals deciduous, petals more than 8 mm long, stamens 50 or more, style longer than the stamens, stigma subcapitate, and mature seeds lustrous and lacking a pellicle.

Phemeranthus parviflorus (Nuttall) Kiger, comb. nov. Basionym: *Talinum parviflorum* Nuttall, in J. Torrey & A. Gray, Fl. N. Amer. 1: 197. 1838. TYPE: U.S.A. Arkansas: n.d., *T. Nuttall s.n.* (possible isotypes or syntypes, K [in type folder, on sheet with *Drummond 34*], K [in general herbarium]).

One of the Nuttall specimens at K is filed in a type folder, but with no indication of status, and bears a Hooker Herbarium label identifying it as *Talinum teretifolium*, an original attribution (to a strictly southeastern species) typical for early American collections from the Midwest and Trans-Mississippi West that actually represent either Nuttall's *T. parviflorum* or Holzinger's *T. rugospermum*. The other sheet at K, in the general collection, also is from Hooker's herbarium and bears a label like that of the first specimen, indicating only "Nuttall" and "Arkansas" (Territory), without number or date. I have found no other specimens that could be types, but since type material of Nuttall's species is scattered in many herbaria, and my search has not been exhaustive, I prefer to delay lectotypification until certain that no holotype exists and that there is no better choice for lectotype. Meanwhile, the specimens at K agree fully with the original description, and there is no doubt about the biological identity of the species or the correct application of Nuttall's name.

Phemeranthus rugospermus (Holzinger) Kiger, comb. nov. Basionym: *Talinum rugospermum* Holzinger, Asa Gray Bull. 7: 117. 1899. TYPE: U.S.A. Wisconsin: Trempeleau Prairie, July 1888, *J. M. Holzinger s.n.* (holotype, WINO transferred to MIN not seen).

Although I have not seen the holotype, I have seen topotypes at GH, K, and RM collected by Holzinger himself in August 1899 and in July 1900, identified by him as *Talinum rugospermum*. As well, I have visited the type location myself and found plants that match Holzinger's description in all details.

Phemeranthus sediformis (von Poellnitz) Kiger, comb. nov. Basionym: *Talinum sediforme* von Poellnitz, Ber. Deutsch. Bot. Ges. 51: 113. 1933. TYPE: Canada. British Columbia: Seme-ke-mele River, 49°N, 15 July 1851, *J. Jeffrey 177* (holotype, B? not located; isotype, K).

The protologue does not indicate the herbarium where the type was deposited, but presumably that was B, where von Poellnitz worked and where his types usually are located. However, I did not find it there.

Phemeranthus thompsonii (N. D. Atwood & S. L. Welsh) Kiger, comb. nov. Basionym: *Talinum thompsonii* N. D. Atwood & S. L. Welsh, Great Basin Naturalist 45: 485. 1985. TYPE: U.S.A. Utah: Emery County, Cedar Mountain, E of Castledale, 19 July 1981, *N. D. Atwood & R. Thompson 8056* (holotype, BRY not seen; isotypes, NY not seen, POM not seen, US).

Phemeranthus validulus (Greene) Kiger, comb. nov. Basionym: *Talinum validulum* Greene, Leafl. Bot. Observ. Crit. 2: 270. 1912. TYPE: U.S.A. Arizona: Coconino County, Tusayan Forest Reservation, 11 Aug. 1912, *R. R. Hill s.n.* (lectotype, selected here, US).

Specimens from Hill's collections usually were deposited in USFS, which later was transferred to RM, except for the types, which went to US. However, there is no specimen now at RM that could be type material of *Talinum validulum*, and there is only the one sheet at US, marked as an isotype and bearing no indication that it came from USFS. In the absence of any evidence that a holotype in the proper sense does or should exist, it seems appropriate to designate the US specimen as lectotype.

Above I have made new combinations for all but four of the species that originally were described in *Talinum* and that will be recognized under *Phemeranthus* in the treatment of Portulacaceae for the *Flora of North America*. Rafinesque transferred Pursh's *T. teretifolium*, as already noted, and recently Hershkovitz (Hershkovitz & Zimmer, 1997) made the combinations needed to transfer *T. brevifolium* Torrey, *T. confertiflorum* Greene, and *T. spinescens* Torrey.

Talinum ciliatum Lindley and *T. trichotomum* Desfontaines also are referable to *Phemeranthus* but are synonyms of *P. teretifolius*. Other names under *Talinum* that pertain to the area covered by FNA and that are referable to *Phemeranthus*, as synonyms of the species transferred herein, include: *T. angustissimum* (A. Gray) Wooton & Standley, *T. aurantiacum* Engelmann var. *angustissimum* Engelmann ex A. Gray, and *T. whitei* I. M. Johnston (= *P. aurantiacus*); *T. eximium* A. Nelson, *T. pulchellum* Wooton & Standley, and *T. youngae* C. H. Mueller (= *P. brevicaulis*); *T. greenmanii* Harsberger (= *P. humilis*); *T. okanoganense* C. S. English and *T. wayae* Eastwood (= *P. sediformis*); and *T. appalachianum* W. Wolf, *T. fallax* von Poellnitz, and *T. gooddingii* P. Wilson (= *P. parviflorus*).

Taxa found in Mexico and Central and South America that do not occur within the FNA area and that also are referable to *Phemeranthus* include: *Talinum cymbosepalum* Rose & Standley, *T. lineare* Kunth, *T. mexicanum* Hemsley, *T. multiflorum* Rose & Standley, *T. napiforme* DC., *T. oligospermum* Brandegee, *T. palmeri* Rose & Standley, *T. parvulum* Rose & Standley, *T. punae* (Fries) Carolin, *T. rosei* P. Wilson, and *T. tuberosum* (Bentham) P. Wilson. I am not making new combinations for these at present, pending further study and resolution of their taxonomic status, thus to avoid needless nomenclatural proliferation.

Acknowledgements. I am grateful to Wendy Applequist and Urs Eggli for very helpful reviews.

Literature Cited

Applequist, W. L. & R. S. Wallace. 2001. Phylogeny of the portulacaceous cohort based on *ndh*F sequence data. Syst. Bot. 26: 406–419.

Carolin, R. 1987. A review of the family Portulacaceae. Austral. J. Bot. 35: 383–412.

———. 1993. Portulacaceae. *In:* K. Kubitzki et al. (editors), 1990+. The Families and Genera of Vascular Plants. Vol. 2, pp. 544–555. 4+ vols. Springer-Verlag, Berlin, etc.

Hershkovitz, M. A. 1993. Revised circumscriptions and subgeneric taxonomies of *Calandrinia* and *Montiopsis* (Portulacaceae) with notes on phylogeny of the portulacaceous alliance. Ann. Missouri Bot. Gard. 80: 333–365.

——— & E. A. Zimmer. 1997. On the evolutionary origins of the cacti. Taxon 46: 217–232.

——— & ———. 2000. Ribosomal DNA evidence and disjunctions of western American Portulacaceae. Molec. Phylogenet. Evol. 15: 419–439.

Rafinesque, C. S. 1814. Specchio delle Scienze o Giornale Enciclopedico di Sicilia. . . . 2 vols. Tipografia di Francesco Abate Qm. Domenico, Palermo.

Taxonomic and Nomenclatural Notes on Chinese *Silene* (Caryophyllaceae)

Bengt Oxelman
Evolutionsbiologiskt Centrum (EBC), Uppsala Universitet, Norbyvägen 18D, SE-75236 Uppsala, Sweden

Magnus Lidén
Botaniska Trädgården, Uppsala Universitet, Villavägen 8, SE-75236 Uppsala, Sweden.
magnus.liden@botan.uu.se (author to whom correspondence should be addressed)

Nicholas J. Turland
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. A revision of the Chinese species of *Silene* L. for the forthcoming account of that genus in the *Flora of China*, Volume 6, necessitates publication of the following two new combinations, one new rank, one replacement name, and three new species: *Silene davidii* (Franchet) Oxelman & Lidén, comb. nov., *S. kialensis* (F. N. Williams) Lidén & Oxelman, comb. nov., *S. herbilegorum* (Bocquet) Lidén & Oxelman, stat. nov., *S. principis* Oxelman & Lidén, nom. nov., *S. sveae* Lidén & Oxelman, sp. nov., *S. tubulosa* Oxelman & Lidén, sp. nov., and *S. tibetica* Lidén & Oxelman, sp. nov.

Key words: Caryophyllaceae, China, *Silene*.

A revision of the Chinese species of *Silene* L. for the forthcoming account of that genus in the *Flora of China*, Volume 6 (Zhou et al., in press), necessitates publication of the following nomenclatural novelties.

Silene davidii (Franchet) Oxelman & Lidén, comb. nov. Basionym: *Lychnis davidii* Franchet, Nouv. Arch. Mus. Paris, sér. 2, 8: 204. 1885 [as "*DAVIDI*"]. *Hedona davidii* (Franchet) F. N. Williams, J. Linn. Soc., Bot. 34: 433. 1899 [as "*Davidi*"]. TYPE: China. Sichuan: "Moupine, in rupibus altissimis," Aug. 1869 (fl), *A. David s.n.* (holotype, P).

Silene kantzeensis C. L. Tang, Acta Bot. Yunnan. 2: 439. 1980. Syn. nov. *Silene caespitosa* Bureau & Franchet, J. Bot. (Morot) 5: 22. 1891, non *Silene caespitosa* Salisbury, Prodr. Stirp. Chap. Allerton, 302. 1796, nom. illeg. [≡ *Silene acaulis* L.], nec *Silene cespitosa* Steven, Mem. Soc. Imp. Naturalistes Moscou 3: 262. 1812 ["*cespitosa*" sic!]. *Melandrium caespitosum* F. N. Williams, J. Linn. Soc. Bot. 34: 431. 1899. TYPE: China. Sichuan: "au sud de Batang, au sommet d'une passe," 1890, *M. Bonvalot & Prince Henri d'Orléans s.n.* (holotype, P).

The name *Lychnis davidii* bears the earliest available epithet for this species, so the above new combination in *Silene* is required.

Silene kialensis (F. N. Williams) Lidén & Oxelman, comb. nov. Basionym: *Melandrium kialense* F. N. Williams, J. Linn. Soc., Bot. 34: 432. 1899. *Lychnis kialensis* (F. N. Williams) H. Léveillé, Cat. Ill. Alph. Pl. Seu Tchouen, 23. 1918. *Silene nepalensis* Majumdar var. *kialensis* (F. N. Williams) C. L. Tang ex C. Y. Wu, in W. T. Wang et al., Vasc. Pl. Hengduan Mount. 1: 423. 1993. TYPE: China. Sichuan: "Tongolo in the principality of Kiala," 1893, *J. A. Soulié 666* (holotype, K; isotype, P).

Melandrium kialense was not treated by Bocquet (1969) in his revision of *Silene* sect. *Physolychnis* (Bentham) Bocquet. The taxon is close to *S. nepalensis* and *S. songarica* (Fischer et al.) Bocquet, but is distinct in calyx size (10–12 mm, not 8–9 mm as in *S. nepalensis*, nor 12–15 mm as in *S. songarica*), quadrifid petal limbs with subequal lobes (not bifid or bifid with small lateral teeth as in the other two species), poorly developed petal claw auricles, and longer androgynophore (1.5–2 mm, not up to 1 mm as in the other two species). Therefore, the above new combination is required.

Silene herbilegorum (Bocquet) Lidén & Oxelman, stat. nov. Basionym: *Silene yetii* Bocquet var. *herbilegorum* Bocquet, Candollea 22: 5. 1967. TYPE: China. Sichuan: "Ta-Tsien-Lu (Ta-Chien-Lu)" [Kangding], s.d., *Pratt 550* (holotype, K; isotype, BM).

Bocquet (1969) suggested that this taxon should deserve specific rank, but felt that the material he had at hand was not enough. He also gave the type specimen as having been collected in 1890 (Bocquet, 1969: 26). We have studied the same material as Bocquet, and conclude that the morphological differences suggest that specific rank is indeed appropriate. The inflorescence has 5 to 10 flowers (1 to 5 in *S. yetii*), the calyx is markedly smaller (9–10 mm, as compared with 12–13 mm in *S. yetii*), and the petal limb is clearly quadrifid (bifid in *S. yetii*).

Silene principis Oxelman & Lidén, nom. nov. Replaced synonym: *Silene platypetala* Bureau & Franchet, J. Bot. (Morot) 5: 22. 1891, non *Silene platypetala* Otth, in de Candolle, Prodr. 1: 383. 1824. TYPE: China. Sichuan: "entre Batang et Litang, dans les petits bois humides," 21 June 1890, *M. Bonvalot & Prince Henri d'Orléans s.n.* (holotype, P).

Silene platypetala Bureau & Franchet, published in 1891, is illegitimate under Article 53.1 of the *Saint Louis Code* (Greuter et al., 2000) because it is a later homonym of *S. platypetala* Otth, which was published in 1824. Therefore, the above new name (nomen novum) is required. *Silene principis* is named after one of the original collectors, Prince Henri d'Orléans.

Silene sveae Lidén & Oxelman, sp. nov. TYPE: China. Yunnan: Dêqên Xian, 45 km N of Zhongdian between Xiao Geza and Geza, 3000 m, gravelly river bank, 16 Sep. 1993, *KGB (Kunming-Göteborg Botanisk expedition till NV Yunnan) 113b* (holotype, UPS).

Herba perennis caespitosa. Caules erecti canescenti-pilosi. Folia crassiuscula, basalia ovata, caulina lanceolata. Inflorescentia pauciflora, floribus primum nutantibus, deinde erectis, parvis. Calyx brevis cylindricus nervis non anastomosis. Petala (atro-)purpurea, auriculis conspicuis, limbis angustis bilobatis. Androgynophorum sparse pilosum, brevissimum. Stamina et styli inclusa.

Herbs perennial, 20–25 cm. Stems few, caespitose, simple, erect, grayish pubescent with short, retrorse hairs throughout. Basal leaves in a persistent rosette, ovate, ca. 3 × 1–1.5 cm, fleshy. Cauline leaves in 2 to 4 pairs, lanceolate, 1–2 cm. Cymules few, 1- to 3-flowered in a lax, irregular thyrse; pedicels very short and sharply deflexed at early anthesis, becoming strictly erect and 1–2 cm in fruit. Fruiting calyx grayish green, cylindric, ca. 7 × 4 mm, base rounded; veins dark green to dark violet, not anastomosing; teeth triangular, margin shortly ciliate, apex acute. Petals slightly exserted; claw ca. 2 mm wide at apex, with narrow, prominently forward-projecting auricles; limb dark red, narrow, ca. 2 mm, deeply bifid with entire lobes. Androgynophore very short, sparsely hairy. Stamens and styles included. Capsule shortly cylindric, subequaling fruiting calyx. Seeds gray, ca. 0.8 mm, minutely tuberculate.

Silene sveae is easily distinguished from *S. caespitella* F. N. Williams by the few and broad basal leaves, from *S. nepalensis* Majumdar by being smaller in all its parts, and from both species by the grayish and slightly fleshy habit, the overwintering leaf rosette, few-flowered inflorescence, prominent, forward-projecting petal auricles, and narrow, deeply bifid petal limbs. *Silene sveae* is named after the sponsor of the Chinese expedition during which this species was discovered, Svea Lindqvist. At present, it is known only from the type collection. *Silene sveae* belongs to the *S. nepalensis* group in section *Physolychnis* (Ruprecht) Bocquet. Despite the sparse material, the distinctive appearance of this plant leaves no doubt about specific rank. All three species have also been studied in cultivation, and *S. sveae* deviates from both the other species in producing only a leaf rosette the first year, whereas the other two species produce flowering stems.

Silene tubulosa Oxelman & Lidén, sp. nov. TYPE: China. Xizang [Tibet]: "Pangkar, Drubla Chu. On granite boulders in deep shade of birch forest. Corolla green. Alt. 11500 feet" [3600 m], 21 Aug. 1938, *F. Ludlow, G. Sherriff & G. Taylor 6877* (holotype, BM).

Herba perennis caespitosa caudice lignoso caulibus erectis vel adscentibus, glanduloso-hirsutis. Folia basalia longe petiolata, laminis ovatis, obtusis vel subacutis. Folia caulina lanceolata vel elliptica, quam basalia breviores. Inflorescentia irregularis, 1–10-flora, laxa. Calyx pallide viridis, campanulatus, deinde inflatus, nervis inconspicuis. Carpophorum dense lanuginosum, circa 2 mm longum. Petala oblonga, erecta, ut videtur sine limbis, tubum formantes. Stamina et styli (3) ex tubum petalorum prominente exserta.

Species valde peculiaris.

Herbs perennial. Rootstock short and sturdy, with a few robust roots, crowned by a few small, sterile leaf rosettes. Stems few, caespitose, erect to ascending, 15–25 cm, with a rather dense mixture of long, glandular hairs and some shorter, reflexed, eglandular hairs. Basal leaves long petiolate with leaf blade decurrent on petiole; petiole 1–4 cm; leaf blade suborbicular to narrowly ovate, 2–5 × 1–4 cm, glaucous and hairy abaxially, especially along

veins and margin, subglabrous adaxially, apex obtuse to subacute. Distal leaves shortly petiolate; leaf blade lanceolate to elliptic, 1–2 × 0.5–1 cm, apex acute. Inflorescence a lax, irregular, unequally branched, 1- to 10-flowered thyrse (as in *Silene* sect. *Odontopetalae* Schischkin ex Chowdhuri and *Physolychnis* (Bentham) Bocquet); cymules long stalked, 2–4 cm, 1(or 3)-flowered, with small, herbaceous, lanceolate bracts; pedicels 5–15 mm. Calyx pale green with indistinct veins, campanulate at first, soon becoming ± inflated and subglobose, sparsely to densely pubescent; teeth obtuse to subacute at apex. Androgynophore ca. 2 mm, densely woolly. Petals "hyaline greenish white" (*Ludlow, Sherriff & Taylor 6185*), ± straight and erect, together forming a short tube exserted from calyx by 1–3 mm, each petal oblong, narrowed toward hairy base, 9–10 mm, ca. 1.5 mm wide at apex, without distinct lamina, claw, or coronal scales; apex truncate, ± irregularly notched or sometimes bifid. Stamens and styles long exserted from petal tube by up to 5 mm. Filaments white; anthers dark brown. Styles 3, greenish white. Seeds unknown.

Silene tubulosa is not similar to any other species of *Silene*. The name alludes to the petals that together form a small tube protruding from the calyx.

Paratypes. CHINA. **Xizang [Tibet]:** "Kyabden, Nyang Chu. On grassy cliff ledges and steep hillsides. Plant viscid. Calyx pale green. Petals hyaline greenish white. Filaments white; anthers dark brown; ovary dark green; styles greenish white. Alt. 13000 feet" [4100 m], 23 Aug. 1938, *F. Ludlow, G. Sherriff & G. Taylor 6185* (BM). Without locality or date, *F. Kingdon Ward 6121* (E).

Silene tibetica Lidén & Oxelman, sp. nov. TYPE: China. Xizang [Tibet]: "near Shipkee La, 31° 40′ N, 78° 44′ E, 9672 feet" [2950 m], July–Aug. 1847, *MacLagan 633* (holotype, E).

Herba perennis breve glanduloso-hirsuta, caudice pluricephalo caulibus erectis vel adscendentibus et rosulis sterilibus. Folia basalia longepetiolata obovata. Folia caulina pauca, late ovata sessilia. Flores in thyrso densiusculis dispositi. Calyx late campanulatus, in fructu latissime apertus. Androgynophorum dense lanuginosum. Petala ex calyce exserta, profunde bifida, dentibus lateralibus instructa. Semina (immatura) dorso longe-papillosa.

Herbs perennial, probably with a densely branched rootstock crowned by dense remnants of dead leaves and cataphylls, shortly glandular hairy. Stems erect or ascending, 10–15 cm. Sterile rosette leaves with petiole 5–6 cm; leaf blade obovate, gradually narrowed into petiole, 3(–4) × 1.5–2 cm, apex subobtuse to acuminate. Cauline leaves in 2 pairs, sessile, broadly ovate, ca. 3.5 × 2.5 cm, apex acute. Inflorescence a dense thyrse consisting of a terminal dichasium and stalked lateral dichasia (stalks ca. 2 cm), each dichasium 3- to 5-flowered; bracts herbaceous, gradually narrowed toward apex, 6–12 × 2–3 mm; pedicels 3–4 mm, that of alar (apical, first) flower to 10 mm. Lateral (later) flowers in dichasium apparently functionally male (an extremely rare condition in *Silene*). Calyx broadly campanulate, 10–12 × ca. 5 mm, expanding to 10–13 mm wide at late anthesis, divided to ca. 1/3 into triangular teeth acute at apex. Androgynophore ca. 3 mm, densely woolly. Petal claws exserted from calyx by 1–2 mm, with rounded auricles; limb oblong, ca. 3 mm, deeply bifid, usually with 2 pairs of lateral teeth; coronal scales short, dentate. Stamens exserted. Styles 5, included or exserted. Seeds (immature) with long, spiny, dorsal papillae.

This species is not similar to any other species of *Silene* known to us. A peculiar feature of the holotype specimen is that only the alar (apical or first) flower is bisexual, whereas the other (later) flowers appear to be functionally male. Although gynomonoecy is a widespread phenomenon in *Silene*, andromonoecy is unknown (although one may encounter odd female sterile flowers occasionally in many taxa). *Silene tibetica* is possibly related to the *S. indica* Roxburgh ex Otth group, where both broad leaves and broad, open calyces occur. *Silene tibetica*, however, differs from previously known species in this group (which is in need of revision) in the short stems, very broad calyces, and in being apparently andromonoecious.

Acknowledgments. Herbarium visits for this study were partly financed from the Royal Swedish Academy of Sciences and funds from the *Flora of China* Project. We are grateful to the curators of the herbaria at BM, E, K, KUN, P, S, and UPS for giving us access to their collections. Constructive criticism from Richard K. Rabeler (MICH) on an earlier draft of this paper is thankfully acknowledged.

Literature Cited

Bocquet, G. 1969. Revisio Physolychnidum. Phanerog. Monogr. 1: 1–342.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Zhou, L. H., Z. Y. [C. Y.] Wu, B. Oxelman & M. Lidén. In press. *Silene* Linnaeus. *In:* Z. Y. Wu & P. H. Raven (editors), Flora of China, Vol. 6, Caryophyllaceae–Lardizabalaceae. Science Press, Beijing, & Missouri Botanical Garden Press, St. Louis.

Two New Species of *Licania* (Chrysobalanaceae)

Ghillean T. Prance
National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Kauai, Hawaii 96741, U.S.A. gtolmiep@aol.com

ABSTRACT. *Licania adolphoduckei* and *L. sothersiae* from the Reserva Florestal Adolpho Ducke near Manaus, Brazil, are described as new, and their relationship within the genus is discussed.

Key words: Amazonia, Brazil, Chrysobalanaceae, *Licania.*

In the course of fieldwork and preparation of an account of the Chrysobalanaceae for a Flora of the Reserva Florestal Adolpho Ducke, 23 km from the city of Manaus, Brazil, two new species have been found that were not included in previous studies of the family (Prance, 1972, 1989). Both species belong to *Licania* subg. *Licania* sect. *Hymenopus* Bentham.

Licania adolphoduckei Prance, sp. nov. TYPE: Brazil. Amazonas: Reserva Florestal Adolpho Ducke, Manaus, 6 May 1997 (fl), *P. A. C. L. Assunção 502* (holotype, INPA; isotype, K). Figure 1.

Species *L. reticulata* affinis sed floribus 1–1.5 mm longis (haud 2.5 mm), foliis 8–13.5 × 3.5–6.5 cm (haud 16–20 × 6–8 cm), laminis versus basim sine glandulis, petiolis decurrentibus, fructibus extus lenticellatis (haud laevis), haud costatis, staminibus 5 (haud 6–7) differt.

Tree to 15 m tall, the young branches glabrous. Leaf lamina oblong, coriaceous, 8–13.5 × 3.5–6.5 cm, cuneate at base, acuminate at apex, the acumen 3–10 mm long, glabrous on both surfaces, with scattered glands beneath; midrib prominulous above, prominent and glabrous beneath; primary veins 12 to 16 pairs, prominulous on both surfaces, 7–11 mm between veins; petiole 4–6 mm long, glabrous, rugose, eglandular, with lamina base slightly confluent. Stipules axillary, interpetiolar, ca. 2 mm long, persistent. Inflorescences of terminal and subterminal racemose panicles, the rachis sparsely puberulous. Bracts and bracteoles ca. 1 mm long, ovate, persistent, chartaceous, puberulous on exterior. Flowers 1–1.5 mm long, borne in few-flowered cymules attached to rachis and primary branches by short peduncles. Receptacle campanulate, sparsely gray puberulous on exterior, tomentose within; pedicels 0.5–1 mm long. Calyx lobes 5, triangular, puberulous on exterior. Petals 5, glabrous on exterior. Stamens 5, inserted around complete circle; filaments shorter than calyx lobes, glabrous, united at mid point, anthers deltoid. Ovary inserted at base of receptacle, puberulous; style puberulous on lower portion. Fruit ovoid, 6–8 cm long, 4–5 cm broad, constricted near to base, exocarp glabrous, lenticellate, mesocarp 1–2 mm thick, endocarp thin, 0.5 mm thick, bony, glabrous within.

Distribution and habitat. Known only from Central Amazonia in the vicinity of Manaus and the Rio Urubu. Growing in forest beside rivers and streams, on sandy soil.

This species is close to *L. reticulata* Prance but differs in the smaller flowers, which are borne in few-flowered cymules on the primary inflorescence branches, the smaller leaves, the bases of which are decurrent onto the petiole, the larger fruit, which is not longitudinally costate, and the smoother much less conspicuous secondary leaf venation. It is also close to *L. laevigata* and differs in the smaller flowers and inflorescence, the sparse gray puberulous rather than densely brown-tomentose exterior of the flowers, the primary veins, which are 7–11 mm apart rather than 12–18 mm, and in the larger ovoid fruit. The large fruit easily distinguishes this species from all other members of the *Licania heteromorpha* complex of section *Hymenopus* L.

Some of the material now placed in *L. adolphoduckei* was previously placed in *L. reticulata* by me (Prance, 1972), and the collections *Ducke 488* and *RB25031* were cited in the original description as paratypes of *L. reticulata.* The detailed collections and observations of the Flora of the Reserva Florestal Adolfo Ducke project have enabled me to distinguish between these two species, and so it is most appropriate to name it for Ducke.

Paratypes. BRAZIL. **Amazonas:** Reserva Florestal Adolpho Ducke, Manaus–Itacoatiara road, km 26, 02°56′S, 59°58′W, 25 Mar. 1997 (fl bud), *J. E. L. S. Ribeiro 1869* (INPA, K), 23 Nov. 1993 (fr), *J. E. L. S. Ribeiro 1162* (INPA, K), 1 Feb. 1995 (fr), *J. E. L. S. Ribeiro 731* (INPA, K), 26 Apr. 1996 (young fr), *J. E. L. S. Ribeiro 1823, 1993* (INPA, K), 26 Apr. 1996 (old fl), *A. Vicentini 350* (INPA, K); Estrada do Aleixo, Manaus, 17 May 1932

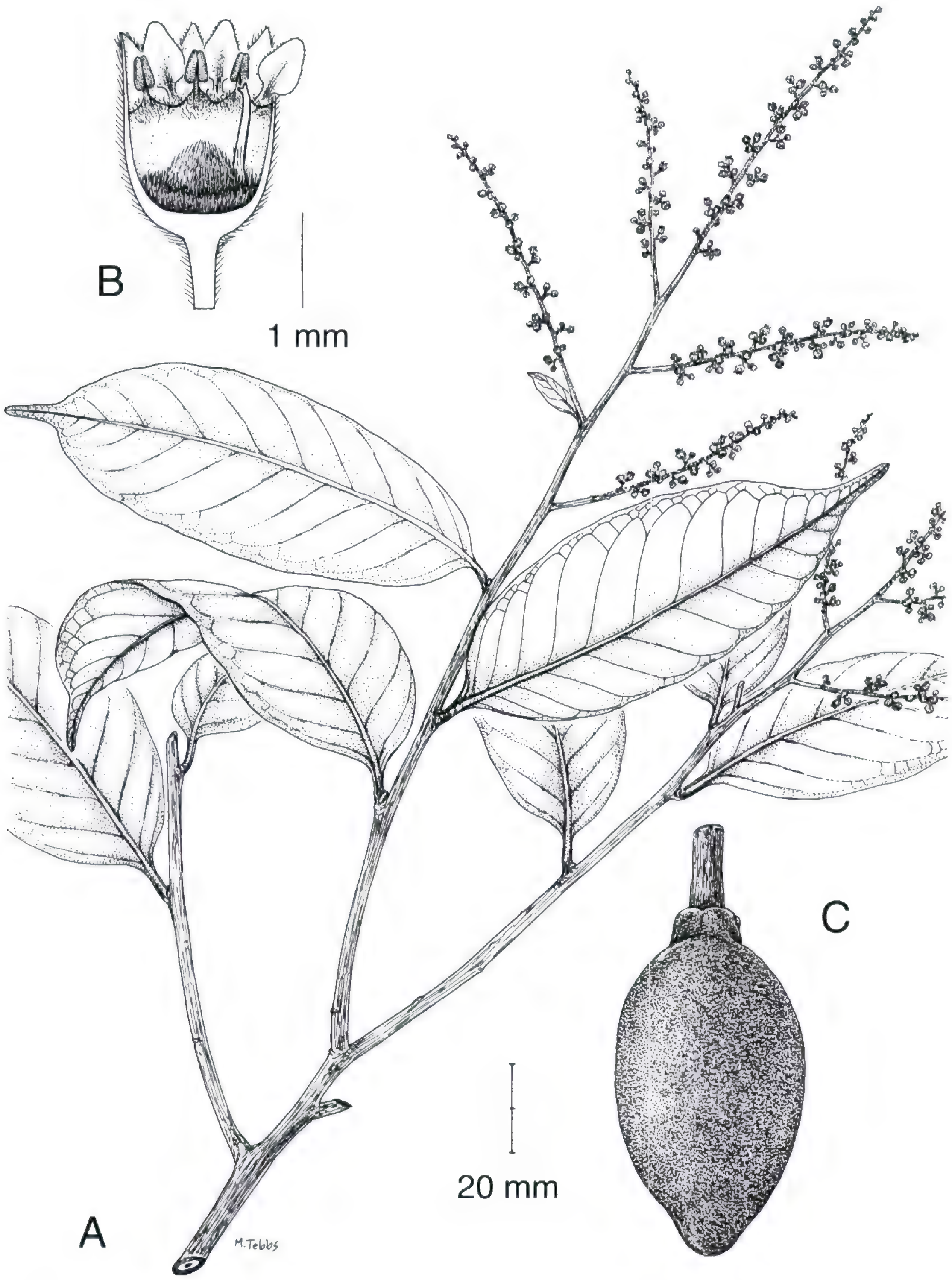


Figure 1. *Licania adolphoduckei* Prance. —A. Habit (*Calderón et al. 2944*). -—B. Half flower (*Assunção 502*). —C. Fruit (*Ribeiro et al. 1162*). (A, C to 20-mm scale and B to 1-mm scale; drawn by M. Tebbs.)

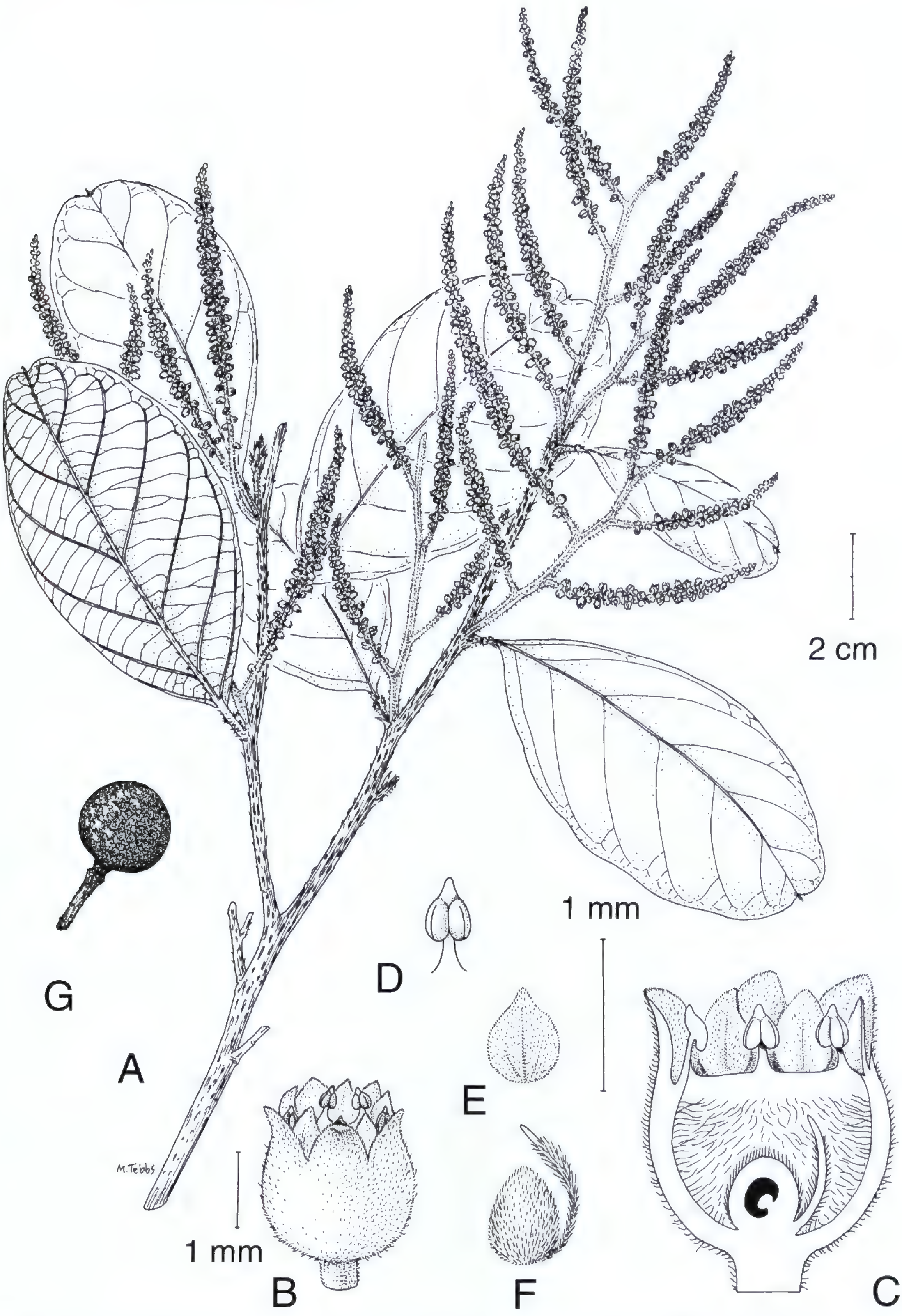


Figure 2. *Licania sothersiae* Prance. —A. Habit. —B. Flower. —C. Half flower. —D. Stamen. —E. Petal. —F. Ovary. —G. Fruit. (A *Ribeiro 1142* and B–G *Ribeiro & Pereira 1878*; A, G to 2-cm scale, B to small 1-mm scale, C–F to large 1-mm scale; A, G drawn by M. Tebbs and B–F drawn by J. M. Fothergill.)

(fl), *A. Ducke RB 25031* (K, RB), 5 May (fl), *A. Ducke 488* (A, F, IAN, K, MO, NY, R, RB 35569, S, US); Rio Urubu, Iracema Falls, 6 Aug. 1979 (fl), *C. Calderón 2944* (INPA, K, US).

Licania sothersiae Prance, sp. nov. TYPE: Brazil. Amazonas: Reserva Florestal Adolpho Ducke, Manaus, 13 Aug. 1993 (fl), *J. E. L. S. Ribeiro 1142* (holotype, INPA 178370; isotype, K). Figure 2.

Species *L. heteromorpha* affinis sed petiolis 8–13 mm longis, ad medium cum glandulis duabus munitis, floribus in cymulis differt.

Tree to 20 m tall, the young branches puberulous-glabrescent with narrowly oblong lenticels. Leaf lamina oblong-elliptic, 5.5–11 × 3–6 cm, retuse at apex, cuneate at base, glabrous above, glabrous beneath except for very few stiff appressed hairs on midrib and primary veins; midrib prominulous above, with few sparse appressed hairs on both surfaces; primary veins 6 or 7 pairs, prominulous above, prominent beneath, secondary venation conspicuously reticulate beneath; petioles 8–13 mm, sparsely hirsutulous, with 2 prominent subopposite glands on middle. Stipules lanceolate, axillary, 5–6 mm long, membranous, caducous. Inflorescences of terminal and subterminal panicles of racemes, the flowers sessile on primary branches and not grouped into cymules, the rachis and branches shortly appressed tomentellous. Bracts and bracteoles minute, 0.5–1 mm long, lanceolate, membranous, persistent. Receptacle campanulate, puberulous on exterior, tomentose within. Calyx lobes acute, puberulous on both surfaces. Petals 5. Stamens 6–7, inserted in a compete circle, filaments shorter than calyx lobes, free to base. Ovary inserted at base of receptacle, lanate pubescent. Style arising to base of anthers, pubescent. Fruit globose, ca. 2 × 2 cm; exocarp glabrous, lenticellate.

Distribution and habitat. Known only from the vicinity of Manaus, Brazil, in forest on terra firme.

This is another taxon resulting from the better understanding of material formerly placed in *Licania heteromorpha* Bentham. The intensive field studies in the Reserva Florestal Adolpho Ducke have led to the recognition of this species and also to the reinstatement of *Licania prismatocarpa* Spruce ex Hooker f., which was placed in synonymy under *L. heteromorpha* in Prance (1972).

Licania sothersiae differs from *L. heteromorpha* and *L. prismatocarpa* in the much longer petioles with two prominent median glands and from *L. prismatocarpa* in the inflorescence with flowers borne directly on the primary inflorescence branches. The specific epithet is for Cynthia A. Sothers, who worked up Chrysobalanaceae for the Field Guide of the Ducke Reserve and who is assisting me with a monograph of Chrysobalanaceae.

Paratypes. BRAZIL. **Amazonas:** Reserva Florestal Adolpho Ducke, Manaus–Itacoatiara road, km 26, 02°56′S, 59°58′W, 16 Dec. 1996 (fr), *C. A. Sothers & C. F. da Silva 959* (INPA, K), 26 Mar 1997 (fr) *J. E. L. S. Ribeiro & E. da C. Pereira 1878* (INPA, K).

Acknowledgments. I thank Cynthia Sothers for providing information for this paper, and the Leverhulme Trust for an Emeritus Fellowship to support this work. I am grateful for use of the facilities of the Herbarium of the Royal Botanic Gardens, Kew, the School of Plant Sciences of Reading University, and the National Tropical Botanical Garden in Hawaii.

Literature Cited

Prance, G. T. 1972. Monograph of Chrysobalanaceae. Flora Neotropica 9: 1–410. Hafner, New York.

———. 1989. Monograph of Chrysobalanaceae, Supplement. Flora Neotropica 9S: 1–267. The New York Botanical Garden, New York.

A Reconsideration of *Chaunanthus* (Brassicaceae)

Robert A. Price
Department of Botany, University of Georgia, Athens, Georgia 30602, U.S.A.

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. Three Mexican endemic species of shrubby habit and apparent thelypodioid affinities (*Iodanthus acuminatus, I. mexicanus,* and *I. petiolatus*) are separated from the eastern North American herb *Iodanthus pinnatifidus* as the genus *Chaunanthus* O. E. Schulz. The new combinations *Chaunanthus acuminatus* and *C. mexicanus* are proposed. The distinguishing features and geographic distribution of the genus *Chaunanthus* are discussed, and a key to species and synopsis of its three included species are presented.

Key words: Brassicaceae, *Chaunanthus, Iodanthus,* Mexico.

Beginning with the revision of Rollins (1942), *Iodanthus* Torrey & A. Gray included four species, three endemic to Mexico (*I. acuminatus* Rollins, *I. mexicanus* Rollins, and *I. petiolatus* (Hemsley) Rollins) and one, the type species *I. pinnatifidus* (Michaux) Steudel, widely distributed in riverine and moist wooded habitats in the eastern half of the United States (Al-Shehbaz, 1988; Rollins, 1993). Alternatively, the one Mexican species published prior to Rollins (1942) was originally treated as a thelypodioid mustard (*Thelypodium petiolatum* Hemsley), and later transferred to the monotypic genus *Chaunanthus* by Schulz (1924). Prantl (1891) allied the monotypic *Iodanthus* with *Cardamine* L. and relatives, whereas Schulz (1936) placed it in a heterogeneous tribe Matthioleae. Molecular sequence comparisons for the chloroplast gene *ndh*F (Price & Sweeney, 1998) strongly indicate that the eastern North American *I. pinnatifidus* is in fact closely related to *Cardamine* L., with which it shares an herbaceous habit, glabrous to sparsely pubescent leaves, white to purplish flowers, and a tendency to grow in mesic habitats. In contrast, the three Mexican species are suffrutescent in habit, have markedly pubescent leaves and yellow to creamy white flowers, and often occur in drier montane habitats. They clearly group in all molecular comparisons to date (Price, unpublished) with *Thelypodium* and relatives in a clade quite distant from *Cardamine* and *I. pinnatifidus.* On the basis of morphological evidence and molecular data, we have reassessed the Mexican species previously placed in *Iodanthus* and treat them below as the separate genus *Chaunanthus.*

Chaunanthus differs from *Iodanthus* by having basally woody stems, wingless petioles, non-auriculate cauline leaves, pubescent leaves and stems, petals undifferentiated into claw and blade, sepals half as long as to subequaling petals, obtuse non-apiculate anthers, well-developed median nectar glands confluent with the lateral nectaries, often secund fruits, and incumbent cotyledons. By contrast, *Iodanthus* has herbaceous stems, winged petioles, auriculate cauline leaves, glabrous leaves and stems, petals strongly differentiated into a blade and claw and more than twice as long as the sepals, strongly apiculate anthers, median nectaries totally lacking, spreading, non-secund fruits, and accumbent cotyledons. In our opinion, these morphological differences are quite significant, and they clearly support the removal of the Mexican species of *Iodanthus* sensu Rollins (1942, 1993) to *Chaunanthus. Chaunanthus* is distinguished from *Thelypodium,* in which *C. petiolatus* was originally placed, by its suffrutescent habit, long petiolate, undivided, dentate, non-auriculate cauline leaves, yellow to creamy-white petals, included stamens, and non-torulose sessile fruits. In contrast, *Thelypodium* is characterized by a biennial herbaceous habit, sessile auriculate or petiolate and pinnately divided (rarely only toothed) cauline leaves, purple, lavender, or white flowers, exserted stamens, and torulose fruits that are often short-stipitate.

Rollins (1942) examined only nine specimens of the three Mexican species that he placed in *Iodanthus.* Although only the type collection of *Chaunanthus mexicanus* is currently known, many collections of *C. petiolatus* and *C. acuminatus* have been made since Rollins's account, so we present below an updated summary of the ecology, distribution, and phenology of the latter two species based upon a much expanded set of collections.

KEY TO THE SPECIES OF *CHAUNANTHUS*

1a. Fruit strongly flattened, long hirsute, attenuate to beak-like apex; stigma sessile; stem apex ending in a leafy, paniculate inflorescence . . . . . 3. *C. mexicanus*

1b. Fruit terete, glabrous or minutely puberulent, cuneate to apex; stigma on a distinct style; stem apex ending in leafless racemes.

2a. Stems hirsute; leaf trichomes exclusively simple; petals 2–3 mm wide . . 1. *C. petiolatus*

2b. Stems glabrous or puberulent; leaf trichomes stalked-forked at least on abaxial surface; petals ca. 1 mm wide . . . . . 2. *C. acuminatus*

1. **Chaunanthus petiolatus** (Hemsley) O. E. Schulz, in Engler, Pflanzenreich IV. 105 (Heft 86): 159. 1924. Basionym: *Thelypodium petiolatum* Hemsley, Diagn. Pl. Nov. Mex. 2. 1878. *Iodanthus petiolatus* (Hemsley) Rollins, Contr. Dudley Herb. 3: 211. 1942. TYPE: Mexico. Hidalgo: Zimapan, *J. M. Coulter 684* (holotype, K; isotype, GH).

Phenology. Flowering July through early October, fruiting September through October.

Habitat. Steep rocky volcanic outcrops, open scrub-oak forests with andesite and basalt boulders; elevation 2000–2850 m.

Specimens examined. MEXICO. **Distrito Federal:** Vertiente E del Cerro de Santa Catarina, cerca de Sta. Catarina, delg. Tláhuac, *Rzedowski 26063* (CAS, MEXU, MICH); Deleg. Tláhuac, 3 km NO de San Francisco Tlaltengo, Ladera SSE del cerro de Sta. Catarina, *García 1675* (MEXU); Lomas de Mixcoac, *Lyonnet 1386* (CAS, MEXU). **Guanajuato:** 2 km al NW de La Gavia, sobre el camino a Cortazar, *Rzedowski 40948* (IEB); 14 km de San Luis de la Paz, vers Victoria, pr, vers Victoria, près de la Presnsita, 21°18′N, 100°26′W, *Caranza Gonzales & Labat 2530* (IEB). **Hidalgo:** Cerro Grande, al SE de Epazoyucan, *Rzedowski 29322* (MEXU); Cerro Alto, 2 km al S de Epazoyucan, *Rzedowski 31127* (ARIZ, MEXU, MICH); Cerro Xihuingo, cerca de Los Cides, Mun. Tepeapulco, *Rzedowski 31504* (MEXU); 2 km al N de Huixmi, Mun. Tlaxiaca, *Rzedowski 36956* (IEB, MEXU); Metztitlán, head of descent into Barranca de Metztitlán between Zoquital and Los Venados, *Moore & Wood 4217* (GH, UC); Zimapan, Cerrote, 10 km sur del entronque de la carr. de Zimapan, *Hernández & Rodríguez 5020* (CAS, MEXU, MO); Pachuca, *Purpus 6512* (F, GH, MO, UC); Cerro Tecajete, Mun. de Zempoala, *Ventura 332* (CAS, MEXU, MICH); Cerro Xihuingo, Mun. de Tepeapulco, *Ventura 473* (MEXU, MICH), *Ventura 2161* (MEXU); Mun. San Agustín Tlaxiaca, Sierra del monte alto de Temoaya, 5 km después de la desviación de la carretera Benito Juárez–Chapulte, 20°05′N, 99°01′45″W, *Díaz 834* (MEXU); Mun. Ajacuba, cerro al NE del poblado Emiliano Zapata, vertiente S de la Sierra de Chicavasco, ejido San Nicolás Tecomatlán, 20°08′50″N, 99°00′45″W, *Díaz 672* (MEXU); Cerro de Santa Monica, N of Santa Monica, 40 km NW of APAM, on Pachuca highway, *West P-26* (MICH). **México:** San Andrés, 5 km al SW de San Cristóbal Ecatepec, *Rzedowski 27633* (MEXU, MICH, TEX); 6 km al W de San Cristóbal Ecatepec, parte alta de la Sierra de Guadalupe, *Rzedowski 32182* (MEXU); Ecatepec, Sierra de Guadalupe, 3 km N Ecatepec, Division Tecuexcomac, entrando por Col. Ampliación, *García 1477* (ARIZ, MEXU, MO, TEX); entre Cuatepec y San Cristobal Ecatepec, Sierra de Guadalupe. *Matuda 25702* (GH, IEB, MEXU, TEX); Sierra de Guadalupe, al N de la Ciudad de México, *Paray 1165* (MEXU); Mt. Guadalupe, near Mexico, *Bourgeau 762* (E, GH). **Puebla:** Boca de Monte, *Purpus 3692* (UC, US). **Queretaro:** parte alta del Cerro La Tembladera, 10.5 km al N de Peña Blanca, Mun. Peñamiller, *Pérez & Zamudio 3238* (IEB).

2. **Chaunanthus acuminatus** (Rollins) R. A. Price & Al-Shehbaz, comb. nov. Basionym: *Iodanthus acuminatus* Rollins, Contr. Dudley Herb. 3: 212. 1942. TYPE: Mexico. Jalisco: Sierra Madre Occidental, San Sebastian, Arroyo Seco, thicket near stream, 15 Jan. 1927, *Ynes Mexia 1491* (holotype, UC).

Phenology. Flowering November through June, fruiting January through October.

Habitat. Clay soil in steep volcanic slopes and flats in forests, deep shade in forest understory; elevation 1200–2600 m.

Specimens examined. MEXICO. **Colima:** Rancho el Jabalí, 20 km N de la Cd. de Colima, cerca de la Hacienda San Antonio, 19°26′N, 103°40′W, *R. & E. Martínez 960* (K); Mun. de Comala, Rancho El Jabalí, 22 km NNW of Colima in SW foothills of Volcan de Colima, 19°26.9′N, 103°42.7′W, *Sanders, Charlton, Phillips & Rothschild 10656* (GH, MICH), *Vazquez 524* (GH, MEXU), *Vazquez & Phillips 891* (MEXU), *Vazques 971* (MO); Rancho El Jabalí, 25 km NNW of Colima, Lago, Epazote, 19°26.6′N, 103°40.7′W, *Sanders, Daniel & Phillips 11017* (MICH); Rancho El Jabalí, 22 Km NNW Colima, Lago Jabalí, 19°26.9′N, 103°41.8′W, *Sanders, Daniel & Phillips 11108* (GH, MICH). **Jalisco:** 5 mi. NNE of Talpa de Allende, E-facing slopes N of road-summit, *McVaugh 20183* (GH, MEXU, MICH); 10–12 km N La Cuesta, below the pass to Talpa de Allende, *McVaugh 233371* (MICH); Sierra Madre Occidental, San Sebastian, E of Segundo Arroyo, *Mexia 1565* (UC); Jocotepec, Cerro Viejo, paraje El Quinto, enfrente de Zapotitan de Hidalgo, *Machuca 6366* (MICH); Cerro Viejo, vereda a Barranca del Agua, *Machuca 3533* (MICH).

3. **Chaunanthus mexicanus** (Rollins) R. A. Price & Al-Shehbaz, comb. nov. Basionym: *Iodanthus mexicanus* Rollins, Contr. Dudley Herb. 3: 213. 1942. TYPE: Mexico. Puebla: Coxcatlan, Sep. 1909, *C. A. Purpus 4158* (holotype, GH; isotypes, MO, UC).

Known only from the type collection.

Acknowledgments. We thank the curators and directors of the herbaria cited in this work. We are grateful to Jerzy Rzedowski for his critical review of the manuscript and for sending photocopies of specimens deposited at IEB.

Literature Cited

Al-Shehbaz, I. A. 1988. The genera of Arabideae (Cruciferae; Brassicaceae) in the southeastern United States. J. Arnold Arbor. 69: 85–166.

Prantl, K. 1891. Cruciferae. *In* A. Engler & K. Prantl (editors), Nat. Pflanzenfam. III. 2: 145–206.

Price, R. A. & P. W. Sweeney. 1998. Relationships in the tribe Cardamineae (Brassicaceae) from *trn*L-F and *ndh*F sequence comparisons. Amer. J. Bot. 85(6, Suppl.): 152.

Rollins, R. C. 1942. A systematic study of *Iodanthus*. Contr. Dudley Herb. 3: 209–215.

———. 1993. The Cruciferae of Continental North America. Stanford Univ. Press, Stanford.

Schulz, O. E. 1924. Cruciferae–Sisymbrieae. *In* A. Engler (editor), Pflanzenreich IV. 105 (Heft 86): 1–388.

———. 1936. Cruciferae. *In* A. Engler & K. Prantl (editors), Nat. Pflanzenfam., ed. 2., 17B: 227–658. Verlag von Wilhelm Engelmann, Leipzig.

Beringia (Brassicaceae), a New Genus of Arabidopsoid Affinities from Russia and North America

Robert A. Price
Department of Botany, University of Georgia, Athens, Georgia 30602, U.S.A.

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

Steve L. O'Kane, Jr.
Department of Biology, University of Northern Iowa, Cedar Falls, Iowa 50614-0421, U.S.A.

ABSTRACT. The new monotypic genus *Beringia* is proposed to include the extremely similar taxa previously treated as *Halimolobos mollis* from northern North America and Greenland, *H. virgata* from western North America, and *Arabidopsis bursifolia* from the Russian Far East. The new combinations *B. bursifolia* and *B. bursifolia* subsp. *virgata* are proposed, and a key to taxa and synopsis of the genus are presented.

Key words: *Arabidopsis*, *Beringia*, Brassicaceae, *Halimolobos*, North America, Russia.

As previously delimited (Schulz, 1924; Al-Shehbaz, 1988; Rollins, 1993), *Arabidopsis* (DC.) Heynhold included a heterogeneous assemblage of unrelated taxa that superficially resemble each other. Molecular studies using chloroplast DNA restriction site or sequence variation (Price et al., 1994; Price, unpublished data), and using the internal transcribed spacer (ITS) regions of nuclear ribosomal DNA (Koch et al., 1999; O'Kane & Al-Shehbaz, in press), coupled with detailed morphological comparisons (see Al-Shehbaz et al., 1999), clearly support the division of the 59 species previously assigned to *Arabidopsis* into smaller, better defined genera. As a result, *Arabidopsis* as now recognized consists of only nine species distributed primarily in Europe, with *A. thaliana* (L.) Heynhold being a cosmopolitan weed, and the range of *A. halleri* (L.) O'Kane & Al-Shehbaz extending into boreal and eastern Asia, while that of *A. lyrata* (L.) O'Kane & Al-Shehbaz extends into boreal and eastern Asia and northern and central North America (O'Kane & Al-Shehbaz, 1997). The generic placement of the great majority of the remaining 50 species of *Arabidopsis* is addressed by Al-Shehbaz et al. (1999), with the exception of the Siberian *A. bursifolia* (DC.) Botschantsev, the northern North American *Halimolobos mollis* (Hooker) Rollins, and the morphologically extremely similar *Halimolobos virgata* (Nuttall ex Torrey & A. Gray) O. E. Schulz from the western United States and Canada. Here we reexamine the relationships of these species and propose a revised treatment under the new genus *Beringia*.

The correct generic placement of the three species treated here in *Beringia* has been a matter of controversy. They have in the past been variously assigned to the genera *Arabidopsis* (Rydberg, 1922; Schulz, 1933; Hultén, 1945; Botschantsev, 1957, 1959; Jurtsev et al., 1975; Berkutenko, 1983, 1988; Czerepanov, 1995), *Arabis* L. (Hopkins, 1937; Busch, 1939; Porsild, 1943; Jurtsev, 1974), and *Halimolobos* Tausch (Schulz, 1924; Rollins, 1943, 1952, 1993; Porsild, 1957; Hultén, 1968). A major cause for this taxonomic confusion is the fact that generic classification in the Brassicaceae has tended to heavily emphasize fruit and seed morphology, which are apparently subject to frequent homoplasy or retained symplesiomorphy (see e.g., Price, 1996, 1997; Koch et al., 1999; Bailey et al., in press). Sequence data from both the chloroplast and nuclear genomes strongly suggest that in addition to a highly heterogeneous group of lineages having been previously placed in *Arabidopsis* sensu lato, both *Arabis* and *Halimolobos* as circumscribed by Rollins (1993) are polyphyletic assemblages, including multiple, well-separated lineages (see Price, 1997; Koch et al., 1999; Bailey et al., in press). All sequence comparisons conducted to date support the exclusion of *Halimolobos virgata* and *H. mollis* from the clade of southwestern North American, Mexican, and South American taxa (halimolobine clade, Bailey, 2001; Bailey et al., in press) that includes the type of *Halimolobos* and the majority of currently recognized species from

the genus. Sequence comparisons of the chloroplast gene *ndh*F (Price, unpublished data) and the nuclear ribosomal DNA ITS regions (O'Kane & Al-Shehbaz, in press; Bailey et al., in press) indicate that the taxa that we are placing in *Beringia* are much more closely related to one another than to any other genus, and that their closest generic relative is the sister genus *Crucihimalaya* Al-Shehbaz, O'Kane & Price. The three taxa of *Beringia* differ in their *ndh*F sequences by a maximum of two base substitutions across a 1523 base pair region of this rapidly changing chloroplast gene, while differing from *Crucihimalaya* by a minimum of 22 base substitutions. ITS sequences for the two taxa assigned to *Beringia* and examined to date (*Arabidopsis bursifolia* from the Russian Far East and *Halimolobos virgata* from Colorado) are identical, providing additional evidence of their close genetic relationship (O'Kane & Al-Shehbaz, in press; D. Bailey, pers. comm.).

Beringia is readily distinguished morphologically from *Crucihimalaya* by having biseriate seeds, fruit valves with prominent marginal veins, and dendritic trichomes especially on its basal leaves. *Crucihimalaya*, which consists of nine primarily Himalayan species (Al-Shehbaz et al., 1999), has uniseriate seeds, fruit valves with obscure marginal veins, and predominantly forked leaf trichomes. *Beringia* is easily distinguished from the more distantly related *Arabidopsis* by having sagittate to auriculate cauline leaves, biseriate seeds, dendritic leaf trichomes, and fruit valves with prominent marginal veins. *Arabidopsis* has petiolate to subsessile but neither sagittate nor auriculate cauline leaves, uniseriate seeds, valves with obscure marginal veins, and leaves with only simple and forked trichomes.

The similarities between *Beringia* and *Halimolobos* are striking, especially in most aspects of flower and fruit morphology. However, the two genera can easily be separated by habit and leaf morphology. Plants of *Beringia* are perennials with a distinct caudex, persistent basal leaf rosettes, entire or rarely minutely toothed cauline leaves, and glabrous fruits. By contrast, species of *Halimolobos* are mostly biennials without distinct caudices or basal leaf rosettes, and they have coarsely dentate to sinuate cauline leaves and stellately or dendritically pubescent fruits. Only two species of *Halimolobos*, *H. palmeri* (Hemsley) O. E. Schulz and *H. parryi* (Hemsley) Rollins, have glabrous fruits, but the other aspects of these two species are clearly characteristic of the genus. As delimited here, *Halimolobos* consists of 12 Mexican species (2 ranging north into the southwestern United States), of which 1 (*H. hispidula* (DC.) O. E. Schulz) extends southward into Argentina, and 3 South American species.

The degree of taxonomic distinctness between the three taxa that we are placing in *Beringia* has also been a matter of controversy. While Rollins (1943, 1952, 1993) recognized *Halimolobos virgata* and *H. mollis* as distinct species, he (1943: 256) suggested that "The similarity between *H. virgata* and *H. mollis* is striking enough so that the two entities might easily be considered to be varieties of the same species." Porsild (1943) took the other extreme by treating the two taxa as conspecific under *Arabis hookeri* Lange. Jurtzev (1975) listed the North American *Turritis mollis* Hooker (= *H. mollis*) as a questionable synonym of the Siberian *Arabidopsis bursifolia*. Berkutenko (1983) placed *H. mollis* in synonymy under *A. bursifolia*, although she later (Berkutenko, 1988) treated their relationship as unresolved, and she indicated that *A. tschuktschorum* Jurtzev is probably an abnormal form of *A. bursifolia*. A critical examination of *A. bursifolia* and *H. mollis* from a wide range of herbarium specimens failed to uncover any consistent morphological differences, and thus we treat *H. mollis* as a synonym of *B. bursifolia*. The finding that ITS sequences for *A. bursifolia* and *H. virgata* are identical (O'Kane & Al-Shehbaz, in press) is also entirely consistent with the treatment of all three taxa as conspecific.

Most of the differences (e.g., stems simple vs. branched at base, plants caespitose or not, fruits terete vs. compressed) given by Rollins (1993) for the separation of *Halimolobos mollis* from *H. virgata* clearly do not hold across the range of currently available herbarium specimens, and the only reliable character that separates them is the distribution and type of trichomes on the upper stems and racemes of the plants, which are glabrous or sparsely pubescent with simple trichomes in *H. mollis* (and *Arabidopsis bursifolia*) and pubescent with branched subappressed trichomes (sometimes mixed with simple ones) in *H. virgata*. Because of this one-character difference and their different geographic distributions (see key), we propose the recognition of the two taxa of the new genus *Beringia* at the rank of subspecies.

Beringia R. A. Price, Al-Shehbaz & O'Kane, gen. nov. TYPE: *Beringia bursifolia* (DC.) R. A. Price, Al-Shehbaz & O'Kane.

Herba perennis; pili ramosi minute stipitati et pilis simplicibus vel furcatis praesentibus; folia basalia rosulata, petiolata, dentata vel integra; folia caulina sessilia, sagittata vel auriculata; racemi ebracteati, valde elongati; se-

pala oblonga, nonsaccata; petala alba; ovulae 35–75 per locula; fructus lineares, teretes, valvae manifeste trinervae; septum completum; semina biseriata, oblonga, mucilaginosa; cotyledones incumbentes.

Herbs perennial, basally hirsute with simple and some forked trichomes, often with dendritic and forked trichomes on other parts. Stems erect to ascending, single or several from the caudex, simple or branched. Basal leaves rosulate, petiolate, simple, dentate to entire. Cauline leaves sessile, sagittate to auriculate, entire to rarely minutely dentate. Racemes several-flowered, ebracteate, corymbose, elongated considerably in fruit; rachis straight. Sepals oblong, deciduous, erect, glabrous or pubescent, base of inner pair not saccate. Petals white, oblanceolate, short clawed. Stamens 6, slightly tetradynamous; anthers oblong, cordate at base, short apiculate at apex. Nectar glands confluent and subtending bases of all stamens. Ovules 35–75 per locule. Fruit dehiscent, linear, terete, glabrous, not torulose; valves with a prominent midvein and marginal veins, secondary veins anastomosing, distinct or obscure; gynophore absent to obsolete; septum complete; style distinct, to 1 mm long; stigma capitate, entire. Seeds biseriate, wingless, oblong, plump; seed coat minutely reticulate, mucilaginous when wetted; cotyledons incumbent.

Beringia is named after the Bering Sea, in relation to the distribution of its plants across both sides of that sea.

Beringia bursifolia (DC.) R. A. Price, Al-Shehbaz & O'Kane, comb. nov. Basionym: *Nasturtium bursifolium* DC., Syst. Nat. 2: 194. 1821. *Arabidopsis bursifolia* (DC.) Botschantsev, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 19: 106. 1959. TYPE: [Russia], Kamtchatka, *Fischer s.n.* (holotype, G-DC).

Turritis mollis Hooker, Fl. Bor.-Amer. 1: 40. 1829. *Arabidopsis mollis* (Hooker) O. E. Schulz, Bot. Jahrb. Syst. 66: 97. 1933. *Halimolobos mollis* (Hooker) Rollins, Rhodora 43: 480. 1941. *Arabis hookeri* Lange, Consp. Fl. Groenland 3: 50. 1880, not *A. mollis* Steven, Mem. Soc. Nat. Moscou 3: 270. 1812. TYPE: "shores of the Arctic Sea, between long. 107° and 130°," *Richardson s.n.* (holotype, K).

Arabis trichopoda Turczaninow, Bull. Soc. Imp. Naturalistes Moscou 13: 63. 1840. *Arabidopsis trichopoda* (Turczaninow) Botschantsev, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 18: 104. 1957. TYPE: [Russia.] Yakutia, between Yakutsk and Aldan, *Turczaninow s.n.* (holotype, LE).

Arabis tschuktschorum Jurtzev, Bot. Zhurn. (Moscow & Leningrad) 59: 1452. 1974. *Arabidopsis tschuktschorum* (Jurtzev) Jurtzev, Bot. Zhurn. (Moscow & Leningrad) 60: 240. 1975. TYPE: Russia. "Penisulae Tschukotskij, ad fl. Putukunei-veem," 22 July 1972, *B. Jurtzev s.n.* (holotype, LE).

Arabidopsis bursifolia var. *beringensis* Jurtzev, in A. I. Tolmatchev, Fl. Arctica URSS 7: 58. 1975. TYPE: Russia. Peninsulae Tschukotskij, near Czegitun, 8 Aug. 1972, *Jurtzev, Sekretareva & Sytin s.n.* (holotype, LE).

Herbs perennial from a simple or branched caudex, densely hirsute basally with primarily simple trichomes to 1 mm long, these often mixed with smaller, forked and/or dendritic trichomes, distally glabrescent or with simple and/or short-stalked, subappressed dendritic trichomes. Stems (5–)10–45(–60) cm tall, 1 to several from the base, erect, simple or branched near base and above. Basal leaves rosulate; petiole 0.3–3 cm long, flattened at base, ciliate; blade oblanceolate to obovate or linear-lanceolate, (0.5–)1.2–6.5(–10) cm long, (2–)3–8(–15) mm wide, pubescent primarily with branched trichomes on both surfaces, base cuneate to attenuate into petiole, margin entire or sometimes dentate, very rarely sinuate, apex obtuse to subacute. Cauline leaves lanceolate to linear-lanceolate or narrowly oblong, middle ones (0.5–)1–3(–4.2) cm long, (1–)2.5–7(–10) mm wide, sessile, strongly sagittate to auriculate, pubescent as basal leaves, margin entire or very rarely minutely few toothed, apex obtuse to subacute. Sepals oblong, 1.2–2.5 × 0.6–1 mm, with a distinct membranous margin, sparsely to densely pubescent with simple and/or branched trichomes. Petals white, oblanceolate, (2.5–)3–4(–4.5) mm long, (0.8–)1–1.5 mm wide, obtuse at apex. Filaments white, slender, 2–2.5 mm long; anthers oblong, 0.4–0.5 mm long. Fruiting pedicels ascending to subdivaricate, slender, straight, (3–)5–14(–18) mm long, glabrous or pubescent with simple or branched trichomes. Fruit linear, erect to erect-ascending, terete, glabrous, smooth, (1.5–)2–3.3(–3.8) cm long, (0.7–)0.9–1.2 mm wide; valves with a prominent midvein and marginal veins, not torulose. Style slender, 0.2–0.8(–1) mm long. Seeds narrowly oblong, 0.8–1 × 0.4–0.5 mm.

KEY TO THE SUBSPECIES OF *BERINGIA BURSIFOLIA*

1a. Upper parts of stem and inflorescence rachis glabrous or sparsely pubescent with simple trichomes; plants of the Russian Far East, Alaska, Yukon, Saskatchewan, and Greenland . . . . . subsp. *bursifolia*

1b. Upper parts of stem and inflorescence rachis with branched subappressed trichomes sometimes mixed with simple ones; plants of Alberta, Saskatchewan, Colorado, Utah, Idaho, and Wyoming . . . . . subsp. *virgata*

Beringia bursifolia subsp. **bursifolia.**

Representative specimens examined. RUSSIA (all from Yakutsky Region and deposited at LE). Niznekolymsky District: Kolyma river basin, 22 June 1973, *Petrovsky s.n.*; Ponteleyka, *Nepli 593.* Abysky District: Indigirskaya lowland, 2 km S of Ozshochino, *Kondratyeva 192.* Yakutia District: near Yakutsk, *Drobov 16, Sokolov 151*; vicinity of Yakutsk Mts. on the Vilyuisky rd. near River Lena, *Abolin 6, Abolin 53*; near Pantelenhy, *Nepli 120*; Kolimsky, on way from Pohodka to Pantelenhy, *Shulga 304.* Tiksi District: near port Tiksi, 3 Aug. 1956, *Shamurin s.n.*; Lena River basin, near Tiksi, 17 July 1955, *Tikhomirov & Shamurin s.n.*; banks of Bolshoy Buluikan, near Tiksi, 9 July 1955, *Tikhomirov, Shamurin & Dorogostayskaya s.n.* Verhoyansky District: basin of Yani river, *Yarovoi 41.* Oymyakonsky District: near Tomtor settlement, S slope of Lisiy Mt., 21 July 1958, *Yutzev s.n.* Churapchinsky District: 20 km from Xhrapchi, *Kuvaev 58–3*; near Sredny-Kolymsk, 15 June 1964, *Permjakova s.n.* CANADA. **Yukon Territory:** Whitehorse, *Gillett & Mitchell 3260* (MO); W slope of Moosehide Mt., Dawson, *Calder & Billard 2902* (MO); Klondike River, Dawson, *Eastwood 117* (NY). **Saskatchewan:** Lipton, *Clokey 1804* (MO). GREENLAND. Qáersuarssuk, 26 July 1927, *Porsild s.n.* (MO); Qeqertat, 11 July 1929, *M. & R. Porsild s.n.* (MO); Etah, *Robinson 31* (GH); Ikerasak i Umanaq Distrikt, 30 July 1935, *Porsild s.n.* (MO); Sydostbugten, N of Qarajaq, *Feilberg 2600* (MO); Itivdleq-Fjord, Qingua, 5 July 1926, *Porsild s.n.* (MO); Foulke Fjord, *Simmons 1466* (GH); Argersiorfik Fjord, 20 July 1924, *Porsild s.n.* (MO).

To our knowledge, the type specimen of *Beringia bursifolia* subsp. *bursifolia* is the single known collection from Kamchatka (Berkutenko, 1988). Although Rollins (1943) reported the subspecies (as *Halimolobos mollis*) from Alaska, we have not seen material from that state. The above material from Saskatchewan was annotated by Rollins as *Halimolobos virgata,* but the plants are glabrous above and their middle parts are exclusively with simple trichomes. Therefore, they should be assigned to subspecies *bursifolia.*

Beringia bursifolia subsp. **virgata** (Nuttall ex Torrey & A. Gray) R. A. Price, Al-Shehbaz & O'Kane, comb. nov. Basionym: *Sisymbrium virgatum* Nuttall ex Torrey & A. Gray, Fl. N. Amer. 1: 93. 1838. *Hesperis virgata* (Nuttall ex Torrey & A. Gray) Kuntze, Revis. Gen. Pl. 2: 935. 1891. *Stenophragma virgata* (Nuttall ex Torrey & A. Gray) Greene, Pittonia 3: 138. 1896. *Pilosella virgata* (Nuttall ex Torrey & A. Gray) Rydberg, Torreya 7: 160. 1907. *Arabidopsis virgata* (Nuttall ex Torrey & A. Gray) Rydberg, Fl. Rocky Mt. 342. 1917. *Halimolobos virgata* (Nuttall ex Torrey & A. Gray) O. E. Schulz, in Engler, Pflanzenr. 86(IV. 105): 290. 1924. TYPE: U.S.A. Rocky Mts. [probably Wyoming], "sources of Sweet Water of the Platte," *Nuttall s.n.* (holotype, BM; isotypes, GH, NY, PH).

Arabis berberiana A. Nelson, Bull. Torrey Bot. Club 25: 383. 1898. TYPE: U.S.A. Wyoming: Carbon Co., Fort Steele, *A. Nelson 3135* (holotype, RM; isotype, NY).

Pilosella stenocarpa Rydberg, Torreya 7: 161. 1907. *Arabidopsis stenocarpa* Rydberg, Fl. Rocky Mt. 342. 1917. TYPE: Canada. Saskatchewan: Wood Mt., Assiniboia, *Macoun 10007* (holotype, NY; isotypes, GH, MO, US).

Representative specimens examined. U.S.A. **Colorado:** Park Co., 4 mi. SW of Fairplay, *Rollins, Weber & Livingston 5169* (GH, MO); 1/4 mi. S of Fairplay, off U.S. hwy. 285, *R. & K. Rollins 83334* (GH, MO). **Utah:** Daggett Co., 12 mi. SW of Manila, *Rollins 2269* (GH). **Idaho:** Butte Co., Big Creek, *Davis 178* (MO). **Wyoming:** Albany Co., Laramie, *A. & E. Nelson 6827* (GH, MO, NY, US), *Porter 3192* (MO); Laramie Hills, *Nelson 1902* (GH, MO, NY, US); Pole Mt., *Porter 3247* (MO); Telephone Canyon, *Williams 2229* (GH, MO); Uinta Co., near Henrys Fork River, between Lonetree and McKinnon, *Rollins 1682* (GH, MO, NY); Sweetwater Co., Leucite Hills, *Merrill & Wilcox 480* (GH, MO, NY). CANADA. **Alberta:** vicinity of Rosedale, *Moodie 949* (GH, MO).

Acknowledgments. We are grateful to Tatyana Shulkina for translating some of the Russian text and herbarium labels and to Donovan Bailey for providing the ITS sequence for subspecies *virgata.* We thank the directors and curators of the cited herbaria.

Literature Cited

Al-Shehbaz, I. A. 1988. The genera of Sisymbrieae (Cruciferae: Brassicaceae) in the southeastern United States. J. Arnold Arbor. 69: 213–237.

———, S. L. O'Kane, Jr. & R. A. Price. 1999. Generic placement of species excluded from *Arabidopsis* (Brassicaceae). Novon 9: 296–307.

Bailey, C. D. 2001. Systematics of *Sphaerocardamum* (Brassicaceae) and Related Genera. Ph.D. Dissertation, Cornell University, Ithaca, New York.

———, R. A. Price & J. J. Doyle. In press. Systematics of the Halimolobine Brassicaceae: Evidence from three loci and morphology. Syst. Bot.

Berkutenko, A. N. 1983. Krestotsvetnye Kolymskogo Nagor'ja. [Brassicaceae of the Kolyma Upland]. 164 pp. Vladivostok.

———. 1988. Brassicaceae. Pp. 38–115 *in* S. S. Charkevicz [Kharkevich] (editor), Plantae Vasculares Orientis Extremi Sovietici, vol. 3. Leningrad.

Botschantsev, V. P. 1957. De Cruciferis notae criticae, II. Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 18: 104–108.

———. 1959. De Cruciferis notae criticae, III. Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 19: 105–108.

Busch, N. A. 1939. *Arabis. In* V. L. Komarov (editor), Fl. URSS 8: 172–197. Academy of Sciences Press, Leningrad.

Czerepanov, S. K. 1995. Vascular Plants of Russia and Adjacent States (the Former USSR). Cambridge Univ. Press, Cambridge.

Hopkins, M. 1937. *Arabis* in eastern and central North America. Rhodora 39: 63–98, 106–148, 155–186.

Hultén, E. 1945. Flora of Alaska and Yukon. V. Lund. Univ. Arsskr. 41: 799–978.
———. 1968. Flora of Alaska and Neighboring Territories. Stanford Univ. Press, Stanford.
Jurtsev, B. A. 1974. Three new taxa from Chukotka and Alaska. Bot. Zhurn. (Moscow & Leningrad) 59: 1452–1453.
———. 1975. *Arabidopsis*. *In* A. I. Tolmatchev (editor), Fl. Arctica URSS 7: 53–59.
———, P. G. Zhukova, T. V. Plieva, V. Y. Raszhivin & N. A. Sekretareva. 1975. Interesting floristic finds in the easternmost Chukotka Peninsula. III. Bot. Zhurn. (Moscow & Leningrad) 60: 233–247.
Koch, M., J. Bishop & T. Mitchell-Olds. 1999. Molecular systematics and evolution of *Arabidopsis* and *Arabis*. Pl. Biol. 1: 529–537.
O'Kane, S. L., Jr. & I. A. Al-Shehbaz. 1997. A synopsis of *Arabidopsis* (Brassicaceae). Novon 7: 323–327.
——— & ———. In press. Phylogenetic position and generic limits of *Arabidopsis* (Brassicaceae) based on sequences of nuclear ribosomal DNA. Syst. Bot.
Porsild, A. E. 1943. Materials for a flora of the continental Northwest Territories of Canada. Sargentia 4: 1–79.
———. 1957. Illustrated flora of the Canadian Arctic Archipelago. Natl. Mus. Canada Bull. 146: 1–211.
Price, R. A. 1996. Chloroplast DNA phylogenies and fruit shape variation in the tribe Arabideae. Amer. J. Bot. 83 (6, Suppl.): 187.
———. 1997. Multiple origins of the genus *Arabis* (Brassicaceae). Amer. J. Bot. 84 (6, Suppl.): 224.
———, J. D. Palmer & I. A. Al-Shehbaz. 1994. Systematic relationships of *Arabidopsis*: A molecular and morphological perspective. Pp. 7–19 *in* E. M. Meyerowitz & C. R. Somerville (editors). *Arabidopsis*. Cold Spring Harbor Laboratory Press, New York.
Rollins, R. C. 1943. Generic revisions in the Cruciferae: *Halimolobos*. Contr. Dudley Herb. 3: 241–265.
———. 1952. A note on *Halimolobos*. Rhodora 54: 161–163.
———. 1993. The Cruciferae of Continental North America. Stanford Univ. Press, Stanford.
Rydberg, P. A. 1922. Flora of the Rocky Mountains and Adjacent Plains. Ed. 2, New York. [Published by the Author.]
Schulz, O. E. 1924. Cruciferae–Sisymbrieae. *In* A. Engler (editor), Pflanzenreich 86(IV. 105): 1–388. Verlag von Wilhem Engelmann, Leipzig.
———. 1933. Kurze Notizen über neue Gattungen, Sektionen und Arten der Cruciferen. Bot. Jahrb. Syst. 66: 91–102.

Transfer of the Cupulate-flowered *Arabis microsperma* and *A. tricornuta* to *Pennellia* (Brassicaceae)

Robert A. Price
Department of Botany, University of Georgia, Athens, Georgia 30602, U.S.A.

C. Donovan Bailey
Department of Plant Sciences, University of Oxford, South Parks Road, Oxford, OXON, OX1 3RB, England

Ihsan A. Al-Shehbaz
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. The new combinations *Pennellia microsperma* and *P. tricornuta* are proposed for *Arabis microsperma* and *A. tricornuta*, which are narrowly endemic species from Chihuahua, Mexico, and southern Arizona. The distinguishing features and geographic distribution of the genus *Pennellia* are discussed, and a synopsis and key to the 11 currently recognized species are presented.

Key words: *Arabis*, Brassicaceae, *Pennellia*.

The generic name *Pennellia* was proposed by Nieuwland (1918) as a new name to replace *Heterothrix* (Robinson) Rydberg, a later homonym of *Heterothrix* Mueller in the Apocynaceae. Schulz (1924) overlooked the name *Pennellia* and recognized three North American and three South American species in *Heterothrix*, but in his subsequent account of the genus (now as *Pennellia*), Schulz (1936) maintained five species and placed one of the South American ones in *Werdermannia* O. E. Schulz. Al-Shehbaz (1990) indicated that the two South American species recognized by Schulz (1936) belong to *Sisymbrium* L. s.l., but we believe that the generic placement of those needs further study.

As presently delimited, *Pennellia* includes 11 species, including the two transferred herein (*P. microsperma* and *P. tricornuta*), the eight species recognized by Rollins (1980, 1993) from Guatemala, Mexico, and the United States (Texas, New Mexico, Arizona, and Colorado), and the disjunct South American *P. boliviensis* (Muschler) Al-Shehbaz, a species distributed in southern Bolivia and northern Argentina (Al-Shehbaz, 1990). The North–South American disjunction of *Pennellia* is exhibited by several other genera of the Brassicaceae, including *Lesquerella* S. Watson, *Mancoa* Weddell, *Thlaspi* L., and *Tropidocarpum* Hooker (Al-Shehbaz & Price, 2001).

Recent molecular systematic studies (Price, 1997; Koch et al., 1999) have suggested that the widespread cruciferous genus *Arabis* L. is a heterogeneous assemblage of several morphologically relatively similar but phylogenetically unrelated lineages. This has served to focus attention on morphologically unusual taxa currently placed within *Arabis* in order to elucidate their evolutionary relationships. In the following paper we reassess the taxonomic position of two species, *A. microsperma* Rollins and *A. tricornuta* Rollins from the southern periphery of the range of *Arabis* sensu lato in North America.

Arabis microsperma was described by Rollins (1993) from oak woodlands in the area of Nabogame in west-central Chihuahua, Mexico, and is currently known only from recent collections in the area of the type locality. *Arabis tricornuta* is a narrow endemic from southeastern Arizona (Rollins in Kearney & Peebles, 1939; Rollins, 1993). Both of these species have been previously noted as being morphologically anomalous within the genus *Arabis* in having a cupulate calyx, a feature typical of several species of the genus *Pennellia* (Rollins, 1993). They were placed in the genus *Arabis* by Rollins on the basis of having silique fruits compressed parallel to the septum and compressed narrowly winged seeds with accumbent cotyledons, in contrast to the terete or slightly compressed siliques with plump, unwinged seeds and incumbent cotyledons typical of *Pennellia*. In fact, Rollins (in Kearney & Peebles, 1939: 478) stated, "*Arabis tricornuta*...is very difficult to distinguish from *Thelypodium micranthum* [now *Pennellia micrantha*]. In habit, inflorescence, flower, and type of pubescence they are almost identical."

Recent phylogenetic analyses of both chloroplast (*ndh*F) and nuclear-encoded (ITS) genes (Price, 1997; Bailey et al., 1999; Bailey, 2001; Bailey et al., in prep.) have allowed an independent assessment of the phylogenetic position of *A. tricornuta*, whereas *A. microsperma* has not yet been available for molecular comparisons. These studies have indicated that *A. tricornuta* forms a well-supported monophyletic group with other representative species of *Pennellia* examined to date (*P. longifolia* (Bentham) Rollins and *P. micrantha* (A. Gray) Nieuwland) and is not closely associated with any of the other known groups examined for *Arabis* sensu lato.

KEY TO THE SPECIES OF *PENNELLIA*

1a. Fruits strongly flattened parallel to the septum; seeds compressed, narrowly to broadly winged; cotyledons accumbent.
  2a. Fruits ca. 1 mm wide; valves obscurely veined; seeds ca. 1 mm long, narrowly winged . . . . . 10. *P. microsperma*
  2b. Fruits 2–3 mm wide; valves with a prominent midvein; seeds ca. 2 mm long, broadly winged . . . . . 11. *P. tricornuta*
1b. Fruits terete or slightly flattened parallel to the septum; seeds usually plump, wingless; cotyledons incumbent.
  3a. Racemes secund in fruit; fruiting pedicels arcuate downward to reflexed; fruits pendent, slightly flattened.
    4a. Petals 9–12 mm long; sepals 7–9 mm long; stamens exserted . . . . . 9. *P. mcvaughii*
    4b. Petals 4–6 mm long; sepals 3–5 mm long; stamens included.
      5a. Lower leaves and stems hirsute with simple and coarsely forked, stalked trichomes; sepals 4–5 mm long . . . . . 8. *P. longifolia*
      5b. Lower leaves and stems tomentose or pubescent with finely dendritic trichomes; sepals 3–4 mm long . . . . . 7. *P. hunnewellii*
  3b. Racemes not secund in fruit; fruiting pedicels divaricate to erect, often straight; fruits erect to divaricate, terete.
    6a. Fruiting pedicels divaricate to horizontal; fruits distinctly not appressed to rachis; raceme lax in fruit.
      7b. Plants glabrous basally; petals 5–6 mm long; seeds uniseriate . . . . . 6. *P. juncea*
      7b. Plants sparsely to densely pubescent basally; petals 3–4 mm long; seeds usually somewhat biseriate.
        8a. Fruiting pedicels (3–)5–9(–10) mm long; sepals 3–4 mm long; petals oblong . . . . . 5. *P. patens*
        8b. Fruiting pedicels 11–17(–21) mm long; sepals 2–3 mm long; petals spatulate . . . . . 4. *P. boliviensis*
    6b. Fruiting pedicels erect to divaricate-ascending; fruit appressed or nearly so to rachis; raceme congested in fruit.
      9a. Fruits 4–6 cm long; fruiting pedicels 10–15 mm long; flower buds and sepals sparsely to densely pubescent . . . . . 3. *P. lasiocalycina*
      9b. Fruits 1.5–3.5(–4.5) cm long; fruiting pedicels (3–)4–7(–8) mm long; flower buds and sepals glabrous.
        10a. Style obsolete; fruits (2–)2.5–3.5(–4.5) cm long; seeds biseriate; sepals purple; petals purplish . . . . . 2. *P. robinsonii*
        10b. Style distinct, ca. 0.5 mm long; fruits 1.5–2 cm long; seeds uniseriate or somewhat biseriate; sepals green; petals white . . . . . 1. *P. micrantha*

1. Pennellia micrantha (A. Gray) Nieuwland, Amer. Midl. Naturalist 5: 224. 1918. Basionym: *Streptanthus micranthus* A. Gray, Mem. Amer. Acad. Arts Sci. 4: 7. 1849. TYPE: U.S.A. [New Mexico]: near Santa Fe Creek, July 1847, *A. Fendler 23* (holotype, GH; isotypes, GH, MO).

Pennellia micrantha is distributed in Colorado (Mineral, Park, and Teller Counties), Arizona (Apache, Cochise, Gila, Graham, Greenlee, Mohave, Pima, and Santa Cruz Counties), New Mexico (Dona Ana, Grant, Lincoln, McKinley, San Miguel, Santa Fe, Sierra, and Socorro Counties), Texas (Brewster, Culberston, Hudspeth, Jeff Davis, and Presidio Counties), and Mexico (Chihuahua, Coahuila, San Luis Potosí, and Sonora). For the geographic distributions of this and the following species, see Rollins (1941, 1980, 1993) and Al-Shehbaz (1990).

2. Pennellia robinsonii Rollins, Contr. Gray Herb. 210: 13. 1980. TYPE: Mexico. Chihuahua: 21 mi. S of Chihuahua City, 15 Oct. 1974, *R. C. Rollins & K. W. Roby 74182* (holotype, GH).

Known from a few collections, all of which are from Chihuahua, Mexico.

3. Pennellia lasiocalycina (O. E. Schulz) Rollins, Contr. Gray Herb. 210: 17. 1980. Basionym: *Heterothrix micrantha* (A. Gray) Rydberg var. *lasiocalycina* O. E. Schulz, in A. Engler, Pflanzenr. IV. 105 (Heft 86): 296. 1924. TYPE: Mexico. Coahuila: Sierra de Parras, 8–9000 m, July 1910, *C. A. Purpus 4604* (holotype, B; isotypes, F, GH, MO, UC, US).

Endemic to Mexico and known from many collections made in Coahuila, Hidalgo, and Nuevo León.

4. Pennellia boliviensis (Muschler) Al-Shehbaz, Harvard Pap. Bot. 2: 13. 1990. Basionym: *Streptanthus boliviensis* Muschler, Bot. Jahrb. Syst. 40: 268. 1908. TYPE: Bolivia. Calderillo, 3200 m, 22 Mar. 1904, *K. Fiebrig 2788* (holotype, B).

Widely distributed in Argentina (Córdoba, Jujuy, Salta, and Tucumán Provinces), but from Bolivia it is known only from the type collection.

5. Pennellia patens (O. E. Schulz) Rollins, Rhodora 62: 16. 1960. Basionym: *Heterothrix patens* O. E. Schulz, in A. Engler, Pflanzenr. IV. 105 (Heft 86): 296. 1924. TYPE: Mexico. Chiapas: District Comitan, 18 Aug. 1898, *C. & E. Seler 3038* (lectotype, designated by Rollins (1980), B; isolectotype, GH).

Widespread in Mexico (Aguascalientes, Distrito Federal, Durango, Hidalgo, Jalisco, México, Michoacán, Oaxaca, Puebla, and San Luis Potosí).

6. Pennellia juncea (O. E. Schulz) Rollins, Contr. Gray Herb. 210: 19. 1980. Basionym: *Heterothrix juncea* O. E. Schulz, in A. Engler, Pflanzenr. IV. 105 (Heft 86): 297. 1924. TYPE: Mexico. Puebla: San Luis, 1908, *C. A. Purpus 3486a* (holotype, B; probable isotype, UC).

Known thus far only from the type collection.

7. Pennellia hunnewellii Rollins, Contr. Gray Herb. 210: 10. 1980. TYPE: Guatemala. Dept. Sacatepéquez: Cumbre de Soledad, Volcán Acatenango, 8500 ft., 16 Feb. 1937, *F. W. Hunnewell 1482* (holotype, GH).

Widespread in Guatemala (Chimaltenango, Huehuetenango, and Sacatepéquez) and Mexico (Hidalgo, Jalisco, México, Oaxaca, Puebla, Queretaro, and Veracruz).

8. Pennellia longifolia (Bentham) Rollins, Rhodora 62: 16. 1960. Basionym: *Streptanthus longifolius* Bentham, Pl. Hartweg. 10. 1839. TYPE: Mexico. "In pasceris montosis, Aguae Calientes," 1837, *Hartweg 52* (holotype, K; isotype, GH).

The most widespread species in the genus. Distributed in Mexico (Aguascalientes? [type collection], Chihuahua, Coahuila, Distrito Federal, Durango, Guanajuato, Hidalgo, Jalisco, México, Michoacán, Nuevo León, Puebla, San Luis Potosí, Sinaloa, Tamaulipas) and in the United States in Arizona (Apache, Cochise, Coconino, Gila, Graham, Greenlee, Mohave, Navajo, Pima, Pinal, and Yavapai Counties), Colorado (La Plata County), New Mexico (Catron, Colfax, Grant, Lincoln, Mora, Rio Arriba, Sandoval, Santa Fe, Sierra, and Socorro Counties), and Texas (Jeff Davis County).

9. Pennellia mcvaughii Rollins, Taxon 28: 24. 1979. TYPE: Mexico. Durango: Sierra Madre Occidental, 26 mi. E of El Salto, near Mexican Hwy. 40, 21 Sep. 1974, *R. C. Rollins & K. W. Roby 7423* (holotype, GH).

Known only from several collections, all of which were made from Durango.

10. Pennellia microsperma (Rollins) R. A. Price, C. D. Bailey & Al-Shehbaz, comb. nov. Basionym: *Arabis microsperma* Rollins, Cruciferae of Continental North America 176. 1993. TYPE: Mexico. Chihuahua: Nabogame, 28°30′N, 108°30′W, 1800 m, 10 Sep. 1987, *J. E. Laferriere 1069* (holotype, GH).

Known thus far only from the type locality.

11. Pennellia tricornuta (Rollins) R. A. Price, C. D. Bailey & Al-Shehbaz, comb. nov. Basionym: *Arabis tricornuta* Rollins, in Kearney & Peebles, J. Wash. Acad. Sci. 29: 478. 1939. TYPE: U.S.A. Arizona: [Pima County], Eastview, Rincon Mts., 13 Oct. 1909, *J. C. Blumer 3478* (holotype, GH).

Endemic to southern Arizona (Cochise and Pima Counties).

Acknowledgments. We are grateful to Andrew Salywon (ASU) and an anonymous reviewer (ARIZ) for their critical evaluation of the manuscript and for providing additional distribution records.

Literature Cited

Al-Shehbaz, I. A. 1990. New or noteworthy species in the South American genera *Mancoa, Pennellia,* and *Sisymbrium* (Brassicaceae). Harvard Pap. Bot. 2: 11–16.

——— & R. A. Price. 2001. The Chilean *Agallis* and Californian *Tropidocarpum* (Brassicaceae) are congeneric. Novon 11: 292–293.

Bailey, C. D. 2001. Systematics of *Sphaerocardamum* (Brassicaceae) and Related Genera. Ph.D. Dissertation, Cornell University, Ithaca.

———, R. A. Price & J. J. Doyle. 1999. Systematics of *Sphaerocardamum*. P. 366 *in* XVI International Botanical Congress Abstracts, St. Louis.

Kearney, T. H. & R. H. Peebles. 1939. Arizona plants: New species, varieties, and combinations. J. Wash. Acad. Sci. 29: 472–492.

Koch, M., J. Bishop & T. Mitchell-Olds. 1999. Molecular systematics and evolution of *Arabidopsis* and *Arabis*. Pl. Biol. 1: 529–537.

Nieuwland, J. A. 1918. *Heterothrix* (B. L. Robins.) Rydb.: A synonym, and other notes. Amer. Midl. Naturalist 5: 224–225.

Price, R. A. 1997. Multiple origins of the genus *Arabis* (Brassicaceae). Amer. J. Bot. 84(Suppl. 6): 224.

Rollins, R. C. 1941. A monographic study of *Arabis* in western North America. Rhodora 43: 289–325, 348–411, 425–481.

———. 1980. The genus *Pennellia* (Cruciferae) in North America. Contr. Gray Herb. 210: 5–21.

———. 1993. The Cruciferae of Continental North America. Stanford Univ. Press, Stanford.

Schulz, O. E. 1924. Cruciferae–Sisymbrieae. *In* A. Engler (editor), Pflanzenr. IV. 105 (Heft 86): 1–388. Wilhelm Engelmann, Leipzig.

———. 1936. Cruciferae. *In* A. Engler & K. Prantl (editors), Nat. Pflanzenfam. ed. 2, 17B: 227–658.

Five New Species of *Richterago* (Compositae, Mutisieae): A Genus Endemic to Brazil

N. Roque

Departamento de Ciências Biológicas, Laboratório de Taxonomia Vegetal,
Universidade Estadual de Feira de Santana, Bahia, Brazil

ABSTRACT. *Richterago*, a genus endemic to Brazil, re-established from *Gochnatia* Kunth, has until now been comprised of 10 species with a center of diversity in the Espinhaço Range, Minas Gerais, Brazil. Five new species of *Richterago*, *R. caulescens*, *R. conduplicata*, *R. elegans*, *R. lanata*, and *R. riparia*, are described and illustrated, bringing the total in the genus to 17. All species are endemic to the campo rupestre vegetation and are characterized by their habit and leaf morphology. *Richterago caulescens* and *R. elegans* are subshrubs, chamaephytes with alternate leaves, the former with rose-colored disc florets; the other new species are herbs, hemicryptophytes with rosulate leaves. *Richterago conduplicata* is distinguished by its obovate and conduplicate leaves; *R. lanata* has oblanceolate leaves that are coriaceous, densely white-lanate, and *R. riparia* has oblanceolate to spathulate leaves that are chartaceous and glabrescent. Commentaries concerning other morphological features of the new species and their ecology and geographical distribution are presented.

Key words: Brazil, Compositae, Mutisieae, *Richterago*.

Richterago Kuntze (Compositae, Mutisieae) has recently been recircumscribed to include species formerly described in *Actinoseris* (Endlicher) Cabrera and *Gochnatia* sect. *Discoseris* Cabrera (Roque & Pirani, in press).

Actinoseris contains radiate species and *Gochantia* sect. *Discoseris* has discoid species, but here these are treated as congeneric, under the name *Richterago*, which in effect returns to the genus concept first employed by Lessing (1830) and goes against the generic concepts more recently proposed by Cabrera (1970, 1971).

Richterago is closely related to *Gochnatia* Kunth and *Ianthopappus* Roque & H. J. N. Hind (Roque & Hind, 2001), due to anther appendages that are apiculate to acuminate. But *Richterago* is distinguished from them by a habit predominantly herbaceous to subshrubby, leaves rosulate or alternate, venation pinnate, capitula homogamous and discoid or heterogamous and radiate, and especially by the pappus, which is uniseriate, with 25 to 42 bristles that are basally united into a fleshy straw-colored ring (Table 1).

Species of *Gochnatia* are commonly trees and shrubs, with leaf venation actinodromous to pinnate, capitula homogamous and discoid and the pappus biseriate, with about 50 bristles that are free; *Ianthopappus* has a subshrubby habit, with leaves actinodromous, capitula heterogamous and radiate, and pappus 3-seriate, with approximately 130 bristles that are free and characteristically purple-colored in contrast to the straw-colored bristles of the former two taxa. *Ianthopappus* was recently described by Roque and Hind (2001). It comprises one species, *I. corymbosus* (Lessing) Roque & D. J. N. Hind, which has a southern extra tropical distribution in the extreme south of Brazil, extending into Argentina (Corrientes) and Uruguay (Artigas).

Richterago is endemic to central-southern Brazil and has 10 accepted species; five are proposed in this paper, bringing the total to 15. The center of diversity of this genus is in the Espinhaço Range, in Minas Gerais State, Brazil (Roque & Pirani, 1997).

1. Richterago caulescens Roque, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Serra do Cipó, km 129 da estrada Belo Horizonte–Conceição do Mato Dentro, 06 Oct. 1981, *I. Cordeiro, M. L. Kawasaki, J. R. Pirani & A. Furlan CFSC 7535* (holotype, SPF; isotypes, BHCB, F, K, MBM, NY, RB, UEC). Figure 1A–G.

Primo aspectu ad *Richteragam polyphyllam* valde accedit, sed foliis glabris, pedunculo brevi, capitulo radiato distincta.

Subshrubs to 50 cm, chamaephytes. Leaves alternate, coriaceous, plane, elliptic, oblong to obovate, 1.5–3 × 0.4–1.5 cm, mucronate, entire to dentate, attenuate, puberulent when young, later glabrous, trichomes glandular-stipitate, camptodromous, reticulate, subsessile, petiole 1–3 mm long, truncate, lanate. Inflorescence peduncle sim-

Table 1. Comparison of *Richterago* Kuntze with *Ianthopappus* Roque & D. J. N. Hind and *Gochnatia* Kunth based on diagnostic morphological studies.

	Ianthopappus[1]	*Gochnatia* s.str.* (Cabrera 1971)	*Richterago*[2]
Habit	Subshrub	Trees or shrubs**	Subshrubs*** or herbs
Leaf venation	Actinodromous	Actinodromous to pinnate	Pinnate
Pappus	3-seriate	2-seriate	1-seriate
Number of pappus setae	Ca. 130	Ca. 50	25 to 42
Pappus setae	Free	Free	United at base into fleshy ring
Pappus coloration	Purplish	Straw	Straw

* *Gochnatia* Kunth excluding *Gochnatia* sect. *Discoseris* Cabrera.
** Woody stem and shoots.
*** Stem unbranched, woody only at the base.
[1] Roque & Hind (2001).
[2] Roque & Pirani (in press).

ple or branched, 2.5–6 cm long, aphyllous, white-tomentose to glabrescent, bracteate; bracts ovate-lanceolate, ca. 5 × 0.2 mm, white-tomentose. Capitula heterogamous, radiate 1 to 12, solitary or forming a congested botryoid or rarely few-headed panicle; involucre cylindrical-turbinate, 1.5–2 × 1–1.5 cm; phyllaries 8–9-seriate, outer ovate, 3–5 × 0.2 mm, inner progressively larger, linear-lanceolate, 0.8–1.1 × 0.1 cm, acute, gray-velutinous. Florets ca. 65, outer-corolla puberulent and trichomes glandular-stipitate; ray florets pistillate, bilabiate, 10 to 15, white, 1.2–1.5 cm long; staminodia ca. 3.5 mm long; disc florets bisexual, tubulate, rose (rarely white), 1.3–1.5 cm long; anthers 5–6 mm long; style ca. 1 cm long. Cypselae 0.9–1.3 cm long, sericeous; pappus bristles 32–42, ca. 7 mm long.

Geographic distribution. Minas Gerais; restricted to campos rupestres vegetation of the Serra do Cipó mountains.

Richterago caulescens is very close to *R. polyphylla* (Baker) Ferreyra in subshrubby leafy habit. It is possibly this characteristic that stimulated Cabrera (1971) to treat these two species as conspecific. However, *R. polyphylla*, endemic to the Planalto de Diamantina (Minas Gerais), has glaucous-tomentose leaves, with indumentum persistent on the abaxial leaf face, a peduncle 10–20 cm long, and a discoid capitulum. *Richterago caulescens*, endemic to the Serra do Cipó (Minas Gerais), has glabrous leaves, a peduncle 2.5–6 cm long, and a radiate capitulum.

Richterago caulescens occurs on sandy and rocky soils among grasses, or on rocky outcrops, mostly as aggregated individuals. This species has showy ray heads and the disc florets are rose-colored, in contrast to its white ray florets.

Populations of *R. caulescens* may occur on rocky outcrops, sympatrically with *R. amplexifolia* (Gardner) Kuntze, whose distribution is also restricted to Brazil (Distrito Federal, Mato Grosso, and Minas Gerais). Under these conditions, individuals intermediate between these two species were observed. These intermediate individuals have a habit similar to *R. caulescens*, but they are more vigorous plants and possess ray or discoid heads. In this work, these specimens have been considered as hybrids.

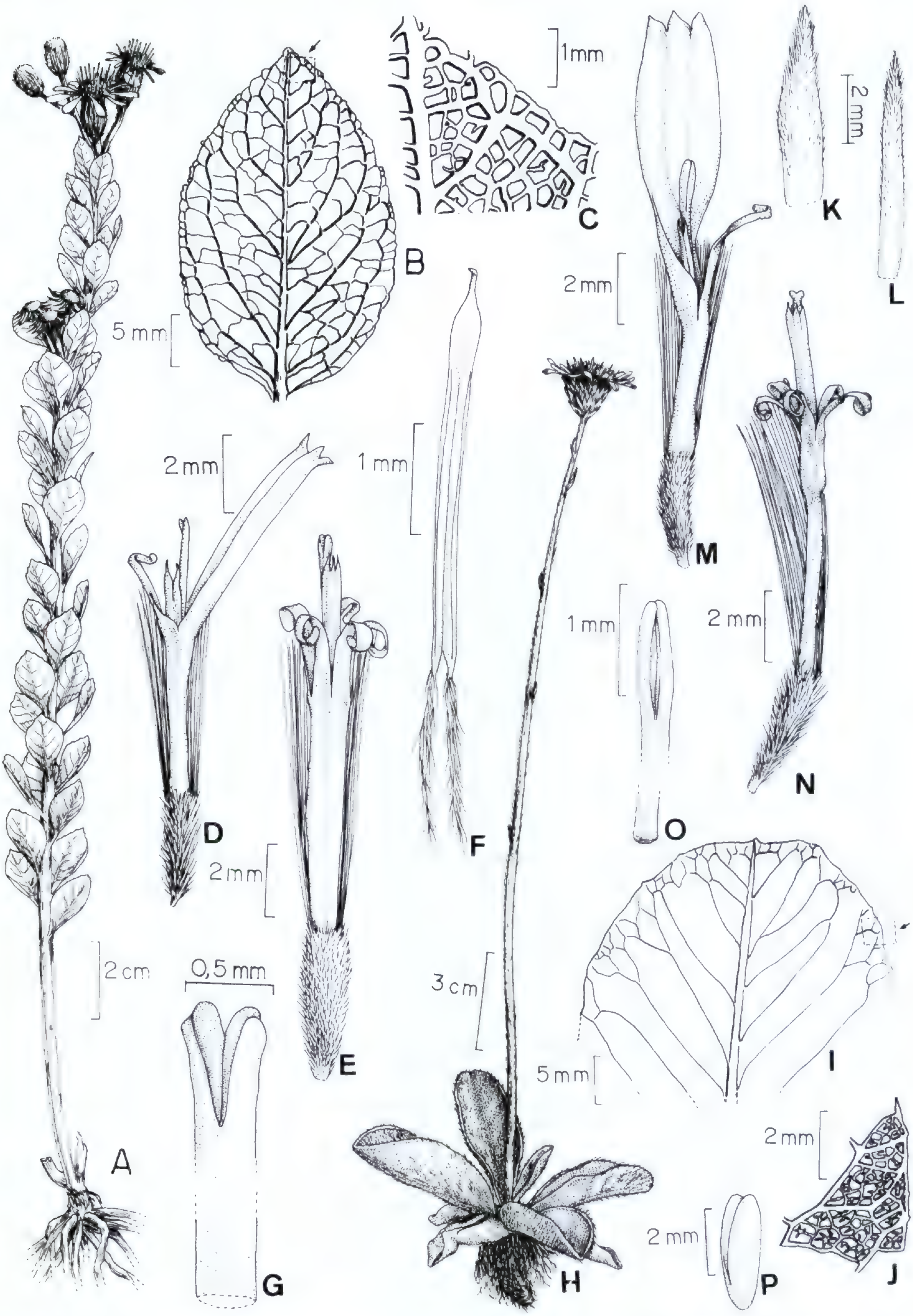
Paratypes. BRAZIL. **Minas Gerais:** Santana do Riacho, Serra do Cipó, 08 Sep. 1987, *Kameyama et al. CFSC 10495* (K, SP, SPF), 24 Aug. 1933, *Mello Barreto 3821* (SP, SPF), 28 Jan. 1999, *Melo et al. 16* (SPF), 25 July 1991, *Pirani et al. CFSC 12428* (K, SPF), 17 Oct. 1992, *Roque CFSC 12992, 12994* (K, SPF), 28 Sep. 1998, *Roque & Hervêncio 470* (SPF, US), 01 May 1993, *Roque & Sakuragui CFSC 13136* (K, MO, SPF), 19 July 1992, *Roque & Sano CFSC 12963* (SPF), 25 June 1997, *Roque et al. 325* (K, SPF), 03 Sep. 1972, *Semir & Sazima CFSC 3331* (UEC).

2. **Richterago conduplicata** Roque, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Serra do Cipó, ca. 22 km da base da Serra, 23 Sep. 1997, *N. Roque, P. Hervêncio, A. C. Araújo 349* (holotype, SPF; isotypes, BHCB, F, HUEFS, K, RB, SP). Figure 1H–P.

Ab omnibus speciebus herbaceis rosulatis generis, foliis conduplicatis differt.

→

Figure 1. A–G, *Richterago caulescens* Roque (drawn from paratype, *Kameyama et al. CFSC 10495*). —A. Habit. —B. Leaf venation. —C. Leaf detail from B (arrow). —D. Ray floret. —E. Disc floret. —F. Anther. —G. Style (apex



and base). H–P, *Richterago conduplicata* Roque (drawn from holotype, *Roque et al. 349*). —H. Habit. —I. Leaf venation. —J. Leaf detail from I (arrow). —K. Outer phyllary. —L. Inner phyllary. —M. Ray floret. —N. Disc floret. —O. Style (apex and base). —P. Embryo.

Herbs 0.15–0.6 m tall, hemicryptophytes. Leaves rosulate, suberect, obovate, conduplicate, 3–10 × 1–4 cm, obtuse, denticulate, base rounded to slightly attenuate, hirsute adaxially, subglabrescent, trichome base persistent (manifested as dark dots), lanate abaxially, becoming velutinous, camptodromous, the veins conspicuous on the abaxial face, subsessile to petiolate, petiole to 1 cm, base expanded laterally, lanate. Inflorescence peduncle 1(to 2), simple, rarely bifurcate, tomentose, glabrescent, bracteate; bract ovate, 0.5–1 cm long, tomentose. Capitula heterogamous, radiate, solitary; involucre hemispheric, 2–3 × 1.5–2.5 cm; phyllaries 7–8-seriate, outer ones ovate-lanceolate, 0.6–1.3 × 1–2 mm, inner ones linear-lanceolate, 1.1–1.5 × 0.5–1 mm, acute, apiculate, velutinous-lanate to sericeous, ciliate, green-vinaceous-colored. Florets 90 to 140, corolla white, externally puberulent and also with trichomes glandular-stipitate; ray florets pistillate, bilabiate, 20 to 30, striations vinaceous-colored on the abaxial face, 1.7–2.5 cm long; staminodia 5–6 mm long; disc florets bisexual, tubulate, ca. 1.4–1.7 cm long; anthers 7 mm long; style ca. 1 cm long. Cypselae 1–1.4 cm long, sericeous; pappus bristles ca. 30, 0.7–1 cm long.

Geographic distribution. Minas Gerais; endemic to Serra do Cipó.

Richterago conduplicata is very close to *R. radiata* (Vellozo) Roque in its habit, and they traditionally have been placed in the same typological species concept (Roque & Pirani, 1997). However, *R. conduplicata* has patent, obovate to conduplicate leaves that are not adpressed in the soil surface; *R. radiata* has adpressed patent, flat and orbicular leaves. Another distinguishing character is the number of peduncles per individual: in *R. radiata* it varies from 1 to 7, while in *R. conduplicata* it is mostly 1, although two specimens (*Roque et al. 316* and *Roque et al. 349*) were observed as having 2.

On Serra do Cipó, both *R. conduplicata* and *R. radiata* are found in similar environments. Although their populations are not fully sympatric, they grow quite close to one another yet remain distinct. *Richterago conduplicata* has a widespread distribution, occurring on sandy or rocky soils (along the road to the Usina Dr. Pacífico Mascarenhas) or on rock outcrops (near Estátua do Velho Juca and Alto do Palácio). In contrast, *R. radiata* occurs in wetter areas such as grasslands, which become boggy during the rainy season, and it can be near rock outcrops.

A phenological study of 10 individuals of *R. conduplicata* was undertaken from September 1992 to August 1993. In September, 90% of these individuals were in anthesis. In October, these same 90% were dispersing fruits. By November, this value had decreased to 40%, and it continued to decline until March, when the entire population was verified as being in the vegetative stage. In August of 1993, the area was burned.

During the dry season, many areas of the campos rupestres are swept by fire, often started to improve pasturage, though natural fires must also occur. Adaptations to withstand fire are therefore also at a premium (Harley, 1995).

Differing from other herbaceous species, *R. conduplicata* maintains its older dried leaves under its new leaves. In this way, the shoot apex remains elevated, to 3 cm above the soil surface, in a position that protects the apical meristem against water loss, burning, or excess heat during the passage of fire.

Paratypes. BRAZIL. **Minas Gerais:** Santana do Riacho, Serra do Cipó, 14 Apr. 1998, *Melo & Vita 9* (SPF), 30 May 1991, *Pirani et al. CFSC 12324* (K, MO, SPF), 19 July 1992, *Roque & Sano CFSC 12959* (K, SPF), 01 May 1993, *Roque & Campos CFSC 13132* (K, SPF), 04 July 1996, *Souza, V. C. et al. 11652* (ESA), 24 June 1997, *Roque et al. 316* (K, SPF), 24 Sep. 1997, *Roque et al. 355* (K, SPF), 29 Sep. 1998, *Roque & Hervêncio 475* (SPF, US), 30 Sep. 1998, *Roque & Hervêncio 502* (SPF, US), 30 Apr. 1972, *Semir & Sazima CFSC 1996* (UEC).

3. Richterago elegans Roque, sp. nov. TYPE: Brazil. Minas Gerais: Diamantina, estrada Diamantina–Conselheiro Mata (MG-220), ca. de 3 km do Córrego das Pedras, 03 Oct. 1997, *A. Rapini, M. L. Kawasaki & R. Mello-Silva 393* (holotype, SPF; isotypes, BHCB, F, RB). Figure 2.

Inter aliis speciebus suffruticosis generis foliis, anguste ellipticis (usque 1 cm latis) insignis.

Subshrubs to 0.9 m, chamaephytes. Leaves alternate, lax or internodes very short, coriaceous, plane when young, elliptic, oblong and ultimately conduplicate, linear, 3–9 × 0.3–0.5 cm (to 1 cm broad when plane), acute, apiculate, entire to denticulate on the apical third, attenuate, glaucous-sericeous with glandular-stipitate trichomes, glabrescent, camptodromous, reticulate on both faces, subsessile, petiole to 3 mm, base expanded laterally, lanate. Inflorescence peduncle simple to branched, to 0.5 m, cinereous-lanate, glabrescent, bracteate; bracts ovate to linear, 1.5–20 × ca. 1 mm. Capitula heterogamous, radiate, rarely inconspicuously radiate, 1 to 4, solitary or normally arranged in a few-headed panicle; involucre cylindrical-turbinate, 1.5 × 0.7–1 cm; phyllaries 10- to 11-seriate, outer ovate, 1.5–3 × 0.5 mm, inner pro-

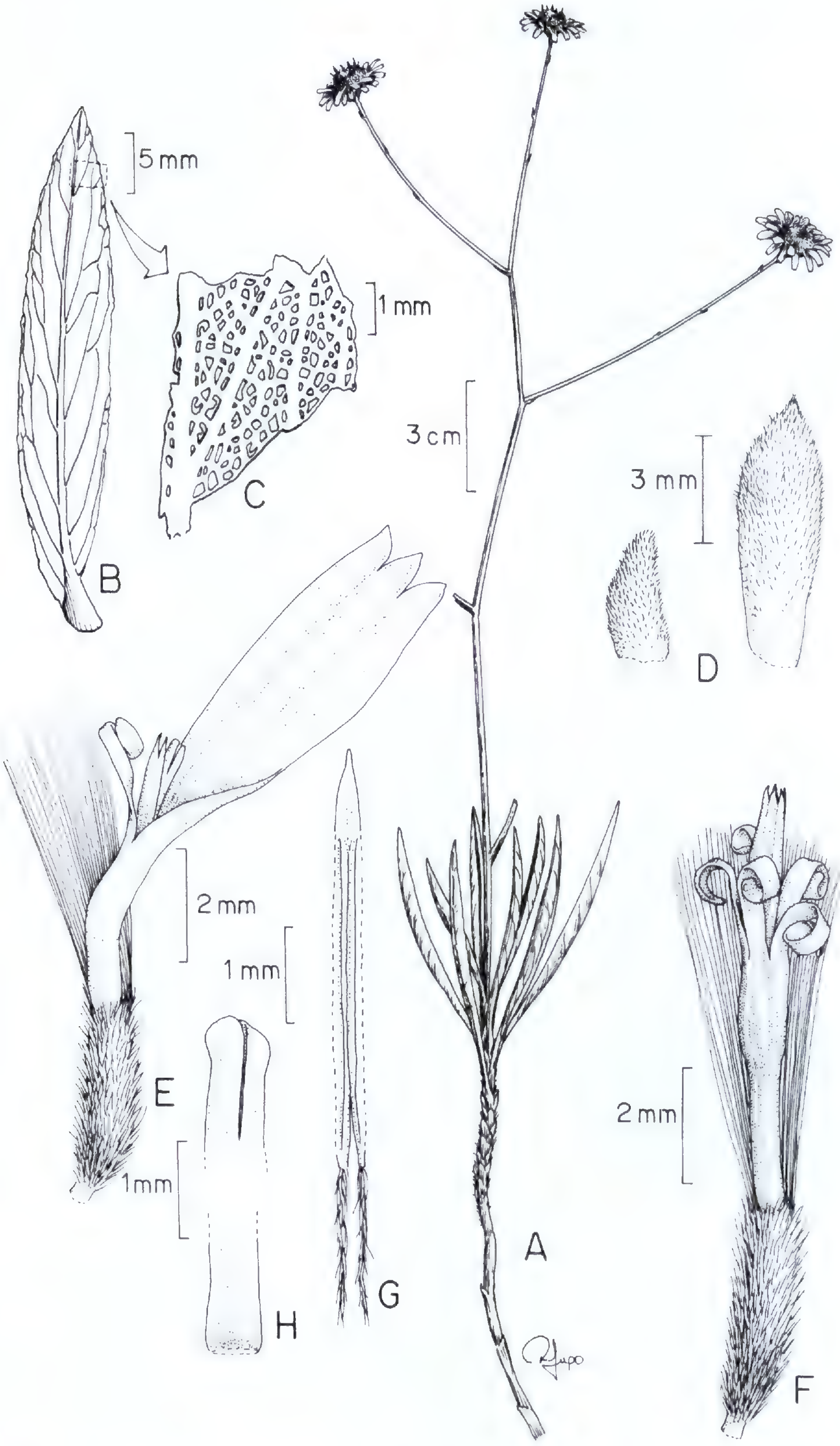


Figure 2. *Richterago elegans* Roque (drawn from paratype, *Harley et al. 25433*). —A. Individual with lower leaves removed. —B. Leaf venation. —C. Leaf detail from B (arrow). —D. Phyllaries. —E. Ray floret. —F. Disc floret. —G. Anther. —H. Style (apex and base).

gressively bigger, lanceolate, 6–9 × 1 mm, acute, acuminate, sericeous, glabrescent, green to vinaceous-colored. Florets 40 to 56, corolla white, externally puberulous and trichomes glandular capitate; ray florets pistillate, bilabiate, 10 to 15, deciduous or not, striations vinaceous-colored on abaxial ligule face, 1–1.6 cm long, staminodia ca. 3.5 mm long; disc florets bisexual, tubulate, ca. 1–1.3 cm long, anthers ca. 4–4.5 mm long, style vinaceous-colored, 8 mm long. Cypselae ca. 8 mm long, sericeous; pappus bristles 30 to 36, ca. 5 mm long.

Geographic distribution. Minas Gerais; restricted to the Diamantina Plateau.

Richterago elegans is characterized by its subshrubby habit, alternate leaves, stem with very short internodes, and capitula that are predominantly radiate and arranged in a few-headed panicle.

Richterago elegans is endemic to campo rupestre vegetation in the Planalto de Diamantina, Minas Gerais. Specimens were collected in grasslands with sandy soils that are flooded during the rainy season.

Richterago elegans, just as *R. campestris* and *R. petiolata* (Roque, 2001), presents variation in capitulum type. Most individuals are conspicuously radiate, but some were collected with a discoid capitulum.

Paratypes. BRAZIL. **Minas Gerais:** Diamantina, 30 Oct. 1981, *Giulietti et al. CFCR 2339, 2367, 2388* (K, SPF, UEC), 30 Oct. 1988, *Harley et al. 25433* (K, SPF), 16 July 1996, *Roque et al. 294* (SPF), 08 Dec. 1997, *Roque et al. 402* (K, SPF), 08 Dec. 1997, *Roque et al. 403* (MO, SPF), 11 Feb. 1998, *Sano et al. 811* (SPF), 23 Sep. 1994, *Splett 621* (UB); Gouveia, 06 Sep. 1971, *Hatschbach 27310* (HB, MBM, RB), 14 Sep. 1985, *Hatschbach & Zelma 49662* (MBM), 20 Mar. 1987, *Hatschbach et al. 51149* (MBM); Santana de Pirapama, 22 Mar. 1982, *Pirani et al. CFCR 8063* (SP, UEC); Serro, 20 July 1987, *Zappi et al. CFCR 11121* (SPF).

4. Richterago lanata Roque, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Serra do Cipó, encosta da Serra da Salitreira, ca. 3 km MG 010, 26 June 1997, *N. Roque, P. Hervêncio & F. A. Vitta 329* (holotype, SPF; isotypes, K, RB). Figure 3A–G.

Ab omnibus speciebus herbaceis rosulatis generis foliis, oblanceolatis dense lanatis demum lanuginosis, floribus radii parvis optime distincta.

Herbs to 70 cm, hemicryptophytes. Leaves rosulate, coriaceous, erect, plane, oblanceolate, rarely elliptic, 12–23 × 2.5–5 cm, acute to obtuse, mucronulate, entire, intramarginal vein present, attenuate, both surfaces densely white-lanate when young, later cinereous-lanuginous, craspedodromous, inconspicuously veined, subsessile to petiolate, petiole to 5 cm, base expanded laterally, lanate. Inflorescence peduncle 1 to 4, simple, cinereous-lanate, bracteate; bracts elliptic, ovate-lanceolate, 1.1–8 × 0.6 cm, lanate. Capitula heterogamous, radiate, solitary; involucre spherical when closed and hemispheric in anthesis, 3–4 × 2–2.5 cm, cinereous-lanate; phyllaries 11- to 15-seriate, subequal, outer ovate-lanceolate, 1.3–1.9 × ca. 0.3 cm, inner linear-lanceolate, 12–15 × ca. 1 mm, acuminate, lanate. Florets ca. 80, corolla white, externally pubescent; ray florets pistillate, bilabiate, 10 to 15, apex vinaceous-colored on the abaxial face, 1.6–1.9 cm long, staminodia ca. 4 mm long; disc florets bisexual, tubulate, 1.6–2.0 cm long; anthers ca. 6 mm long; style 1.1–1.2 cm long. Cypselae 1.2–1.7 cm long, sericeous; pappus bristles ca. 30, 0.9–1.3 cm long.

Geographic distribution. Minas Gerais; endemic to Serra do Cipó.

Richterago lanata was formerly included in the circumscription of *R. arenaria* (Baker) Roque (Roque, 1997). These two species are the only ones in the genus that have leaves covered by white-lanate indumentum and craspedodromous venation with an intramarginal vein. However, *R. lanata* is characterized by clumped individuals, a vigorous habit (more than *R. arenaria*), and leaves erect in relation to the peduncle, white-lanate leaves, later becoming cinereous-lanuginate, entire, and opaque with faint venation. *Richterago arenaria* tends to grow as isolated individuals, with a lanate indumentum that is lost when mature and usually with denticulate leaf margins.

The capitulum of *R. lanata* is subglobose in bud, becoming diametrically expanded during anthesis. The ray florets are not showy as compared to the species from this group (*R. polymorpha*, *R. radiata*, *R. arenaria*). However, it has been observed that these florets emit a strong sweet smell at anthesis, which is probably important in attracting pollinators. This character is not well known in other species.

Richterago lanata has been found in the campo rupestre vegetation, among rocks, in sandy to rocky soils along roadsides, and in the fissures of small rock outcrops (Serra da Salitreira).

Paratypes. BRAZIL. **Minas Gerais:** Congonhas do Norte, Serra da Carapina (Serra Talhada), Norte da Serra do Cipó, 02 Mar. 1998, *Rapini et al. 541* (K, SPF); Santana do Riacho, Serra do Cipó, 09 Oct. 1987, *Abbud et al. CFSC 10752* (MO, SPF, UEC), 16 May 1990, *Arbo et al. 4264* (K, SPF), 30 Mar. 1949, *Barroso s.n.* (BHCB

Figure 3. A–G, *Richterago lanata* Roque (A, B drawn from holotype, *Roque et al. 329*; C–G from paratype, *Rapini et al. 541*). —A. Habit. —B. Leaf venation. —C. Ray floret. —D. Disc floret. —E. Anther. —F. Style (apex and base). —G. Embryo. H–Q, *Richterago riparia* Roque (H, K–Q drawn from holotype, *Roque & Hervêncio 493*; I from paratype, *Hatschbach 29986*; J from paratype, *Hatschbach 30046*). —H. Habit. —I. Petiole base cleared to show vascular strands. —J. Leaf detail from H (arrow). —K. Outer phyllary. —L. Inner phyllary. —M. Ray floret. —N. Disc floret. —O. Anther. —P. Style (apex and base). —Q. Embryo.

376), 15 Mar. 1962, *Duarte 6462* (RB), 06 Mar. 1972, *Joly et al. CFSC 1251* (UEC), 25 Apr. 1978, *Lima 362* (RB, SP, UEC), 31 Jan. 1980, *King & Almeda 8387* (UB, US), 14 Apr. 1998, *Melo & Vitta 5* (SPF), 27 Jan. 1999, *Melo et al. 12* (SPF), 17 Oct. 1992, *Roque CFSC 12998* (SPF), 08 Aug. 1993, *Roque & Campos CFSC 13347* (K, SPF), 30 Sep. 1998, *Roque & Hervêncio 497* (SPF, US), 14 Feb. 1996, *Roque et al. 179* (SPF), 23 Oct. 1997, *Sano et al. 654* (K, SPF), July, *s. coletor s.n.* (RB).

5. Richterago riparia Roque, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Parque Nacional da Serra do Cipó, km 107.5 da Estrada Belo Horizonte–Conceição do Mato Dentro, 30 Sep. 1998, *N. Roque & P. Hervêncio 493* (holotype, SPF; isotypes, BHCB, F, MBM, NY, UB, US). Figure 3H–Q.

Ab omnibus speciebus herbaceis rosulatis generis caule prostrato rhizomatoso, foliis interdum alternatis oblanceolatis ad spathulatis differt.

Caespitose herbs 12 to 30 cm, hemicrytophytes; stem prostrate, rhizomatous, to 10 cm. Leaves rosulate or alternate with very short internodes, chartaceous, erect, plane, opaque, oblanceolate to spathulate, 2.5–12 × 0.2–1(1.4) cm, apex acute, callous (rarely obtuse), acuminate, margin entire or denticulate on apical third, attenuate, pubescent when young, glabrescent, trichome bases persistent (as dark dots), camptodromous, inconspicuous venation, subsessile to petiolate, petiole to 6 cm, base expanded laterally, lanate. Inflorescence peduncle simple or branched (2 or more), villous, glabrescent, bracteate; bracts lanceolate to linear, 0.2–1 cm, glabrescent. Capitula 1 to 3, heterogamous, radiate, solitary or arranged in a few-headed panicle; involucre cylindrical-turbinate, 1–1.5 cm diam., vinaceous-green-colored; phyllaries 7–9-seriate, lanceolate, outer 3–4 × 0.5 mm, inner 8–9 × 0.5 mm, acute, sericeous, glabrescent. Florets 40 to 68, corolla white, externally puberulous and with glandular-stipitate trichomes; ray florets bilabiate, 10, ca. 1.4 cm long; staminodia 3 mm long; disc florets pistillate, tubulate, 1.2 cm long; anthers 5 mm long; style 9 mm long. Cypselae ca. 1 cm long, sericeous; pappus bristles 25 to 27, ca. 8 mm long.

Geographic distribution. Minas Gerais; campo rupestre vegetation in the Serra do Cipó mountains, also known from Carmo do Rio Claro.

Richterago riparia is frequent on Serra do Cipó growing in rock cracks, along the edges of the streams, and in shady places. Recently, a major population was encountered bordering a temporarily dry stream. These individuals were densely aggregated as well as in clumps along the edge of the stream, forming a green carpet. Some clumps were located in low spots along the border of the stream, and so were probably covered by water during the rainy season. Even during the dry season these clumps had moist roots, for they grew in dense humus material, resembling peat.

The leaves of *R. riparia* are chartaceous, flat, oblanceolate to spathulate, opaque, denticulate in the apical third, with inconspicuous venation. The species is close to *R. angustifolia, R. hatschbachii* (Zardini) Roque, and *R. stenophylla* (Cabrera) Roque, which are delicate herbs whose inflorescences are arranged in few-headed panicles and whose capitula have 10 ray florets. However, these species are easily distinguished from *R. riparia* by their leaf morphology: *R.* angustifolia has coriaceous leaves that are commonly involute, oblanceolate, with the apex and base callous with conspicuous venation; *R. hatschbachii* presents oblong-spatulate leaves that are flat and denticulate; and *R. stenophylla* has narrow-linear leaves.

Paratypes. BRAZIL. **Minas Gerais**: Carmo do Rio Claro, 05 Sep. 1961, *Andrade 1016 & Emmerich 977* (HB, RB); Santana do Riacho, Serra do Cipó, 18 May 1983, *Andrade et al. 1430* (BHCB), 26 July 1989, *Anjos 108* (BHCB, UEC, US), 01 Feb. 1987, *Barros 1285* (SP), 02 May 1993, *Barros 2816* (SP, SPF), 07 Sep. 1980, *Forero et al. 8012* (SP, SPF), 01 July 1981, *Giulietti et al. CFSC 7423* (SP, SPF, UEC), 06 Aug. 1972, *Hatschbach 29986* (BR, MBM, US), 07 Aug. 1972, *Hatschbach 30046* (MBM, NY), 07 June 1970, *Joly et al. CFSC 291* (UEC), 28 July 1991, *Luque & Menezes 12* (SPF), 26 July 1972, *Menezes 255* (RB, SPF), 29 May 1991, *Pirani et al. CFSC 12379* (SPF), 07 Nov. 1991, *Prado 25658* (UEC), 29 Apr. 1973, *Semir et al. CFSC 4064* (UEC), 30 Sep. 1977, *Tenório 77–1433* (MBM, US), 09 Sep. 1987, *Zappi et al. CFSC 10555* (MO, SPF).

Acknowledgments. I am grateful to the curators of the cited herbaria for the loan of material. Logistic support was provided by the Universidade de São Paulo during my Ph.D. studies. Special thanks are due to José Rubens Pirani for assistance with the Latin diagnoses and for useful comments. I also thank Jerônimo Vergne de Morais (UEFS) for the Latin review.

Literature Cited

Cabrera, A. L. 1970. *Actinoseris*, nuevo género de Compuestas. Bol. Soc. Argent. Bot. 13: 45–52.

———. 1971. Revisión del género *Gochnatia* (Compositae). Revista Mus. La Plata 12(66): 1–160.

Harley, R. M. 1995. Introduction. *In:* B. L. Stannard (editor), Flora of the Pico das Almas–Chapada Diamantina–Bahia, Brazil. Royal Botanic Gardens, Kew.

Lessing, C. R. 1830. Synanthereis Herbarii Regii Berolinensis, Dissertatio Tertia. Linnaea 5: 237–263.

Roque, N. 1997. A reassessment of *Actinoseris polymorpha* (Less.) Cabrera (Compositae, Mutisieae) with a new combination. Kew Bull. 52: 197–204.

——— & J. N. Nakajima. 2001. Two new species of *Richterago* Kuntze (Compositae, Mutisieae) from Minas Gerais and Goiás, Brazil. Kew Bull. 56: 697–703.

——— & D. J. N. Hind. 2001. *Ianthopappus*, a new genus of the tribe Mutisieae (Compositae). Novon 11: 97–101.

——— & J. R. Pirani. 1997. Flora da Serra do Cipó, Minas Gerais: Compositae–Barnadesieae e Mutisieae. Bol. Bot. Univ. São Paulo 16: 151–185.

——— & ———. In Press. Reinstatement of the name *Richterago* Kuntze and recircumscription of the genus to include species formerly treated as *Actinoseris* (Endl.) Cabrera (Compositae, Mutisieae). Taxon.

Gynerieae, a New Neotropical Tribe of Grasses (Poaceae)

J. Gabriel Sánchez-Ken & Lynn G. Clark
Department of Botany, Iowa State University, Ames, Iowa 50011-1020, U.S.A.

ABSTRACT. *Gynerium* was traditionally classified in the reed tribe Arundineae in the Arundinoideae, but recent molecular studies strongly support its affinities with the Panicoideae + Centothecoideae clade. A new tribe, the Gynerieae, is described to accommodate *Gynerium*.

Key words: Gynerieae, *Gynerium*, Neotropics, Poaceae.

Gynerium P. Beauvois, known as *caña brava* or giant reed, is a widespread, Neotropical, reed-like grass. The genus is characterized by its reedy habit, tightly distichous leaves, leathery blades with wide midribs, dioecy, and plumose pistillate synflorescences. The plants are probably the tallest among the grasses, excluding the woody bamboos, with some culms per population reaching 10(–15) m in height. This monotypic genus is distributed from southern Mexico to northeastern Argentina, as well as in the West Indies, and occurs along river banks and in swampy habitats. Locally, the culms are used for construction and decoration, and the peduncles are used as shafts for hunting arrows (Kalliola & Renvoize, 1994).

Due to the resemblance in habit and synflorescences, *Gynerium* has traditionally been classified with the other common reed-like grasses, including *Arundo* L. and *Phragmites* Adanson, in the tribe Arundineae (Kunth, 1833; Renvoize, 1981; Clayton & Renvoize, 1986; Conert, 1987; Dallwitz et al., 1999). In a few other classifications, however, *Gynerium* was included in other tribes such as the Festuceae (Hitchcock, 1914), Cortaderieae (Caro, 1982), or Danthonieae (Watson & Dallwitz, 1992). All of these classification systems were based on morphological and anatomical features.

Analyses of individual molecular sequence data sets provided conflicting results with respect to the phylogenetic relationships of *Gynerium*. Hsaio et al. (1998), based on nuclear ribosomal internal transcribed spacer (ITS) sequences, supported a monophyletic Arundinoideae, including *Gynerium*. Other taxa traditionally referred to this subfamily, such as *Thysanolaena* Nees, *Micraira* F. Mueller, and the danthonioid grasses, were also resolved as members of the Arundinoideae, although Hsiao et al. did not recover a monophyletic Arundineae. Outgroup selection, however, was limited to two species from outside of the PACC clade, and therefore alternative topologies were not rigorously tested. More detailed analyses of the PACC clade, as part of an analysis of ITS sequence data for the entire family (Hsiao et al., 1999), confirmed the placement of *Gynerium* within an arundinoid clade, but bootstrap values were very low. In contrast, Barker (1997), using plastome *rbc*L sequence data, placed *Gynerium* within a Panicoideae + Centothecoideae clade, either as sister to the Panicoideae or sister to *Thysanolaena* in the Centothecoideae, with moderate to good support values.

The Grass Phylogeny Working Group (GPWG, 2000, 2001) combined eight character sets, both molecular and morphological, in phylogenetic analyses of the entire Poaceae. Only four of these data sets (*rbc*L, *rpo*C2, ITS, and morphology) were available for *Gynerium*, but in the combined analyses, *Gynerium* was placed within the Panicoideae + Centothecoideae clade, whose monophyly was reasonably well supported (Fig. 1). Within this clade, *Gynerium* appears as sister to the Panicoideae, but with only moderate support values at best. Preliminary results based on molecular and morphological data from a more detailed study of the Panicoideae and Centothecoideae subclades corroborate the placement of *Gynerium* within the Panicoideae + Centothecoideae (Sánchez-Ken & Clark, 2000; E. A. Kellogg, pers. comm.), but its position remains unstable within this clade.

Gynerium is strongly supported as a member of the Panicoideae + Centothecoideae clade, but robust resolution of its phylogenetic position within this clade awaits further study. Nonetheless, the genus appears to be isolated from other tribes and genera in this clade, including the reed-like *Thysanolaena*, which is embedded within the Centothecoideae. We therefore propose tribal status for *Gynerium*, but cannot confidently place it in either the Panicoideae or Centothecoideae at this time.

Gynerieae Sánchez-Ken & L. G. Clark, tribus nov.
TYPE: *Gynerium* P. Beauvois.

Plantae perennes, rhizomatosae, dioeciae; culmis 2–10(–15) m altis; internodiis solidis. Folia disticha; vaginis quam internodiis longioribus, arctis, persistentibus; lam-

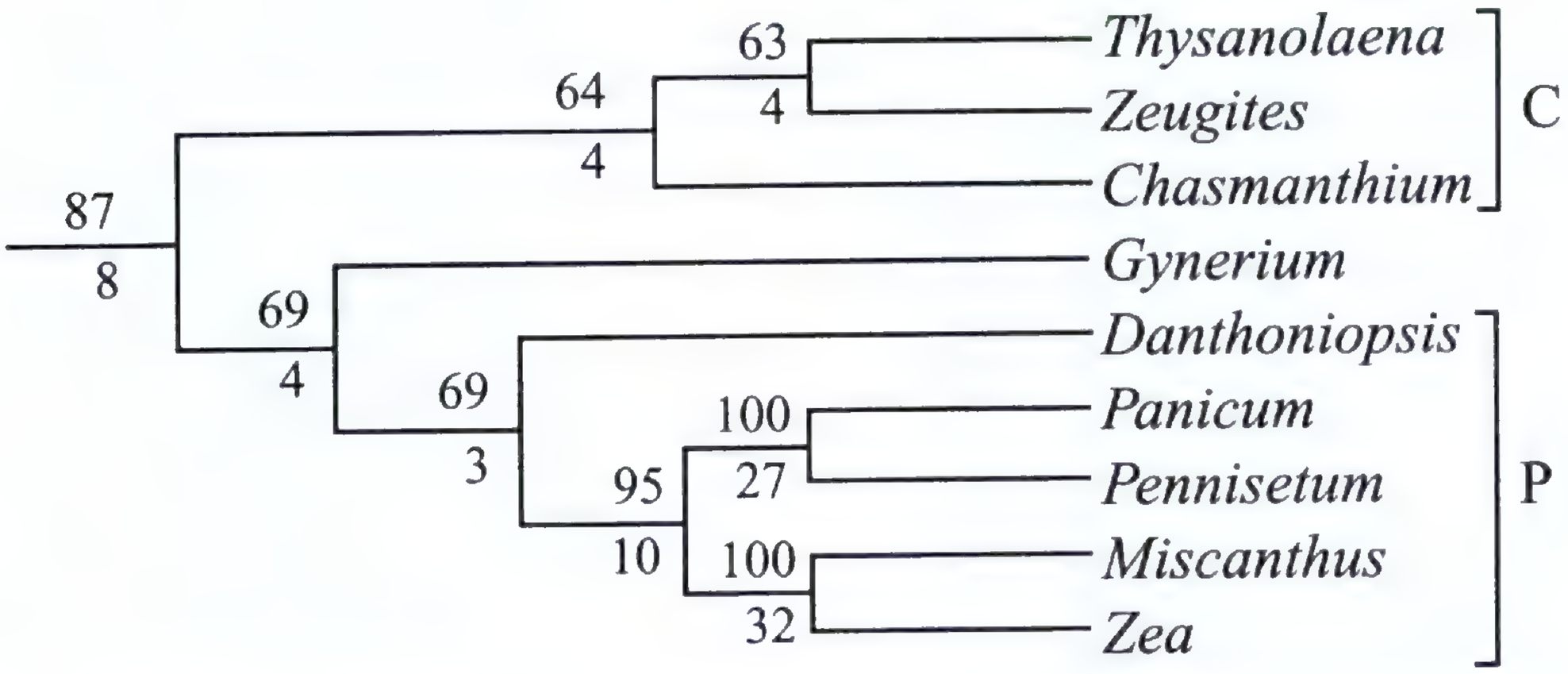


Figure 1. Phylogeny of the Panicoideae + Centothecoideae clade from GPWG (2001), with bootstrap values above the branches and Bremer support values below. C = Centothecoideae; P = Panicoideae.

inis (0.4–)1.5–2 m longis, coriaceis, articulatis, non pseudopetiolatis, costa 0.5–1.5 cm lata, plerumque conspicua. Synflorescentiae paniculatae, pistillatis plumosis. Spiculae pistillatae bifloscultatae; glumis inaequalibus, inferiore membranacea, superiore coriacea, longiore quam flosculis; lemmatibus sursum villosis, ad apicem elongatis, attenuatis, non aristatis; lodiculis 2, truncatis, membranaceis; stylis 2, liberis; rachillae extensione carente. Spiculae staminatae 2- ad 4-flosculatae; glumis inaequalibus; lemmatibus glabris vel sparsim breviter pilosis; lodiculis 2; staminibus 2.

Plants perennial, rhizomatous, dioecious, staminate and pistillate plants similar in gross morphology. Culms 2–10(–15) m tall including the synflorescences; internodes solid. Leaves distichous; sheaths longer than the internodes, tightly enclosing the internodes, persistent; collar pilose on young leaves with rudimentary blades; ligules pilose; blades (0.4–)1.5–2 m long, leathery, articulated with the sheaths, disarticulating up to the middle of the culms, not pseudopetiolate, the midrib 0.5–1.5 cm wide, usually conspicuous. Synflorescences paniculate, the pistillate plumose. Pistillate spikelets with 2 florets, disarticulating above the glumes and between the florets; glumes unequal, 1- to 3-nerved, the upper glume longer and firmer than the lower glume, exceeding the florets; callus linear, glabrous; lemmas long silky pilose above, the apex elongated and narrowed, not awned; lodicules 2, free, truncate, membranous, sometimes bearing a few long hairs, faintly 2- or 3-nerved; stamens 2, rudimentary; styles 2, free; rachilla extension absent. Staminate spikelets with 2 to 4 florets, disarticulating below the distalmost floret, glumes and lowermost floret remaining attached; glumes subequal, membranous, 1-nerved; lemmas membranous, glabrous or sparsely short pilose, (0)1(3)-nerved; lodicules 2, free, faintly nerved, truncate; stamens 2; ovary abortive. Caryopsis oblong, hilum punctate. Chromosome number: $x = 11$.

The name is taken from the Greek *gyne*, "woman," and *erion*, "wool," referring to the pistillate spikelets. This tribe includes one genus with only one species, *G. sagittatum* (Aublet) P. Beauvois, which is distributed from the Caribbean and southern Mexico to tropical Argentina.

Acknowledgments. We thank CONACyT-Mexico (fellowship 119472) for its sponsorship of the first author. Final preparation of the manuscript was supported by NSF Grant DEB-9806877 to LGC.

Literature Cited

Barker, N. P. 1997. The relationships of *Amphipogon*, *Elytrophorus* and *Cyperochloa* (Poaceae) as suggested by *rbc*L sequence data. Telopea 7: 205–213.

Caro, J. A. 1982. Sinopsis taxonómica de las gramíneas argentinas. Dominguezia 4: 1–51.

Clayton, W. D. & S. A. Renvoize. 1986. Genera Graminum, Grasses of the World. Her Majesty's Stationery Office, London.

Conert, H. J. 1987. Current concepts in the systematics of the Arundinoideae. Pp. 239–250 *in* T. R. Soderstrom, K. W. Hilu, C. S. Campbell & M. E. Barkworth, Grass Systematics and Evolution. Smithsonian Institution Press, Washington, D.C.

Dallwitz, M. J., T. A. Paine & E. J. Zurcher. 1999 onward. User's Guide to the DELTA Editor. http://biodiversity.uno.edu/delta/

Grass Phylogeny Working Group. 2000. A phylogeny of the grass family (Poaceae) as inferred from eight character sets. Pp. 3–7 *in* S. W. L. Jacobs & J. Everett, Grasses: Systematics and Evolution. CSIRO Publishing, Collingwood, Victoria.

———. 2001. Phylogeny and subfamilial classification of the grasses (Poaceae). Ann. Missouri Bot. Gard. 88: 373–457.

Hitchcock, A. S. 1914. A Text-Book of Grasses. MacMillan, New York.

Hsiao, C., S. W. L. Jacobs, N. P. Barker & N. J. Chatterton.

1998. A molecular phylogeny of the subfamily Arundinoideae (Poaceae) based on sequence of rDNA. Austral. Syst. Bot. 11: 41–52.

———, ———, N. J. Chatterton & K. H. Asay. 1999. A molecular phylogeny of the grass family (Poaceae) based on the sequences of nuclear ribosomal DNA (ITS). Austral. Syst. Bot. 11: 667–668.

Kalliola, R. & S. A. Renvoize. 1994. One or more species of *Gynerium*? (Poaceae). Kew Bull. 49: 305–320.

Kunth, C. S. 1833. Enumeratio Plantarum. Vol. I Agrostographia Synoptica. Enumeratio Graminum. J. G. Cottae, Stuttgart and Tübingen.

Renvoize, S. A. 1981. The subfamily Arundinoideae and its position in relation to a general classification of the Gramineae. Kew Bull. 36: 85–102.

Sánchez-Ken, J. G. & L. G. Clark. 2000. Overview of the subfamily Centothecoideae (Poaceae). Amer. J. Bot. Suppl. 87: 163. [Abstract.]

Watson, L. & M. J. Dallwitz. 1992. The Grass Genera of the World. C.A.B. International, Wallingford, Oxon, England.

Myrocarpus emarginatus (Leguminosae, Papilionoideae, Sophoreae), a New Species from Bolivia

Ângela L. B. Sartori & Ana M. G. Azevedo Tozzi

Departamento de Botânica, Instituto de Biologia, Universidade Estadual de Campinas, Caixa Postal 6109, Campinas 13083-970, SP, Brazil

ABSTRACT. *Myrocarpus emarginatus*, known only from Bolivia, is described and illustrated. Its diagnostic characters are the emarginate leaflet apex, pellucid dots and streaks immersed on the leaflet blades, and the areolate reticulation of the seed chamber. The new species is morphologically similar to *Myrocarpus fastigiatus* Allemão, especially in the shape of its leaflets, ranging from elliptic to oblong; neither species exhibits leaflets with an acuminate apex.

Key words: Bolivia, Leguminosae, *Myrocarpus*, Papilionoideae, Sophoreae.

Myrocarpus Allemão is a small legume genus placed in the tribe Sophoreae (De Candolle, 1825; Bentham, 1865; Polhill, 1981, 1994) due to its leaves being pinnate, a calyx valvate in bud, a corolla with 5 petals, but these not much differentiated, stamens 10 and free, as well as the lack of jointed fruits. The genus itself can be recognized by the presence of pellucid dots and streaks in the leaflets, a regular corolla, and marginally winged fruit. The most recent taxonomic treatment of *Myrocarpus* was by Rudd (1972), who recognized four species based mainly on the size of leaflets and fruits, and the shape of the leaflet apex. Five species are spread across South America from Venezuela to Argentina. *Myrocarpus leprosus* Pickel and *M. fastigiatus* Allemão are restricted to Brazil: the first is endemic to the state of São Paulo, and the second occurs from Rio de Janeiro to Pernambuco. Both can be encountered from the Brazilian coastal regions, mainly in Atlantic rainforest. *Myrocarpus venezuelensis* Rudd occurs in Venezuela and Brazil in gallery forest. Of broadest distribution is *M. frondosus* Allemão, which is found in Brazil, Paraguay, and Argentina in a variety of habitats including mesophytic forests, Atlantic rainforest, and gallery forest. During a taxonomic revision of *Myrocarpus* (Sartori, 2000) at the Universidade Estadual of Campinas, UNICAMP, Brazil, it became necessary to propose a new name for a striking species from Cochabamba and vicinity, Bolivia.

Myrocarpus emarginatus A. Sartori & A. M. G. Azevedo, sp. nov. TYPE: Bolivia. Cochabamba: Campero, bajada del Buena Vista al Rio Grande, 17°27″S, 63°40″W, 27 Jan. 1993, *C. Antezana 614* (holotype, BOLV; isotype, MO). Figure 1.

Myrocarpus emarginatus M. fastigiato nobis similis, sed apice emarginato, punctis lineolisve pellucidis notatis et in laminae locis depressis, pericarpio praeter alas areolato, petiolis, petiolulis, foliolis, stipitis majoribus differt.

Arbor 3–9 m alta. Folia imparipinnata 7–9-foliolata; petioli 2.0–2.7 cm longi; rachis 5.0–8.7(–11.2) cm longa; petioluli 4.0–4.8 mm longi, foliola ca. 3.5–4.2 cm longa et 2.6–3.0 cm lata, elliptica, apice emarginato, basi inaequali, utrinque glabrescentia, punctis lineolisve pellucidis notatis et in laminae locis depressis. Flores non visi. Fructus samaroideus, stipitatus, glaber, compressus, ellipticus, elongatus, ca. 5.2–7.7 cm longus et 1.0–1.3 cm latus, pericarpium incrassatum praeter alas, areolatum, 0.5–0.8 cm latum.

Tree 3–9 m, branches slightly square in cross section, lenticel inconspicuous, stipules deciduous. Leaves imparipinnate, 7- to 9-foliolate. Petiole, rachis, and petiolules glabrous, petiole 2.0–2.7 cm long; rachis 5.0–8.7(–11.2) cm long; petiolules 4.0–4.8 mm long; leaflets alternate, elliptic or sometimes oblong, 3.5–4.2 × 2.6–3.0 cm, the lower pairs smaller, the apex emarginate, the base inequilateral, rarely cuneate, margins smooth, not revolute, both surfaces glabrous, concolorous, venation brochidodromous, veins prominent on upper blade face, secondary veins forming an acute angle with the primary leaflet vein, dots and streaks pellucid, conspicuous, immersed. Flowers unknown. Samaras 5.2–7.7 × 1.0–1.3 cm, yellowish, stipe 5.7–8.0 mm long, seed chamber areolate, 5–8 mm wide, pale yellowish brown, calyx and stamens persistent, the apex wings obtuse, sometimes apiculate, the base inequilateral.

Myrocarpus emarginatus can be recognized by its emarginate leaflet apex, pellucid dots and streaks immersed on leaflet blades, as well as the areolate reticulation of the seed chamber. The new species closely resembles *Myrocarpus fastigiatus*, especially in the lack of an acuminate leaflet apex. How-

Figure 1. *Myrocarpus emarginatus* A. Sartori & A. M. G. Azevedo. Fruiting branchlet. Scale = 2 cm. (Drawn from *C. Antezana 614*, MO.)

ever, *M. fastigiatus* exhibits a retuse leaflet apex, the pellucid dots and streaks are not immersed in the leaflet blade, and the seed chamber has scalariform reticulation; its leaflets are smaller than 3.5 × 2.0 cm, and its petiole, petiolule, and stipe are shorter than 1.5 cm, 4.0 mm, and 4.5 mm long, respectively. *Myrocarpus emarginatus* can be distinguished by its larger leaflets and longer petiole, petiolule, and stipe. The distribution and habitat of the two species do not overlap: *Myrocarpus emarginatus* is found in Bolivia, growing in xerophytic forest; *M. fastigiatus* occurs in Brazilian coastal regions from Rio de Janeiro to Pernambuco, growing in Atlantic rainforest.

Even in the absence of floral material, specimens of *Myrocarpus emarginatus* are obviously recognizable as distinctive within the genus by the areolate reticulation of its seed chamber and emarginate leaflet apex.

In the tribe Sophoreae, only *Myrocarpus*, *Myroxylon* L.f., and *Myrospermum* Jacquin exhibit pellucid dots and streaks on leaflet blades. Vegetative material of *Myrocarpus emarginatus* can sometimes be confused with specimens of *Myrospermum*, but its thinly coriaceous leaflets, with an emarginate leaflet apex, and its prominent veins on the upper surface of its leaflets distinguish *Myrospermum* from the new species described herein. Specimens of *Myrospermum* can be characterized by their membranous leaflets, retuse leaflet apexes, and the veins not prominent on the upper surfaces of leaflets. The geographic distribution of *Myrospermum* from Central America to northeastern South America has been established, and *Myrospermum emarginatus* is endemic to Bolivia (Sartori, 2000).

Myrocarpus emarginatus is known from the department of Cochabamba, Bolivia. According to the type collection (*C. Antezana 614*), this taxon occurred in xerophytic forest and was observed on stony soils with *Neocardenasia herzogiana* Backeberg, *Schinopsis haenkeana* Engler, and *Cochlospermum tetraporum* Hallier f., at altitudes of 1170–2050 m. In Cochabamba, it is commonly called Quina-quina as indicated on the type label. Fruits were collected in January (for the holotype) and April (paratype *M. Fernandez 2*).

The specific epithet refers to the emarginate leaflet apex, which provides a conspicuous vegetative character.

Paratypes. BOLIVIA. **Cochabamba:** Campero, Rio Grande, 25 Oct. 1999, *C. Antezana 1342* (BOLV); Campero, Bajada Quinarí, Rio Mizque, 12 Apr. 1999, *M. Fernandez 2* (BOLV).

Acknowledgments. We are grateful to C. Antezana for facilitating access to her collections, V. C. Hollowell and two anonymous reviewers for critical comments for improving the manuscript, T. M. Filgueiras for assistance with the Latin diagnosis, V. Bittrich for review of the English text, and L. M. Joly for preparing the illustration. This work was supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

Literature Cited

Bentham, G. 1865. Leguminosae. *In* G. Bentham & J. D. Hooker, Genera Plantarum, pars 1, v. 1: 552–560. Facsimile ed. 1965, Verlag von J. Cramer, Weinheim.

Candolle, A. P. De. 1825. Leguminosae. *In* A. P. De Candolle, Prodromus Systematis Naturalis Regni Vegetabilis, 2: 92–95. Treuttel et Würtz, Paris.

Polhill, R. M. 1981. Sophoreae. *In* R. M. Polhill & P. H. Raven (editors), Advances in Legume Systematics v. 1: 213–230. Royal Botanic Gardens, Kew.

———. 1994. Classification of the Leguminosae. *In* F. A. Bisby, J. Buckingham & J. B. Harbone (editors), Phytochemical Dictionary of the Leguminosae 84: 35–50. Chapman & Hall, New York.

Rudd, V. E. 1972. A new species of *Myrocarpus* (Leguminosae) and a brief resume of the genus. Phytologia 23: 401–404.

Sartori, A. L. B. 2000. Revisão taxonômica e estudos morfológicos de *Myrocarpus* Allemão, *Myroxylon* L.f. e *Myrospermum* Jacq. (Leguminosae Papilionoideae Sophoreae). Ph.D. Thesis, Instituto de Biologia, Universidade Estadual de Campinas.

Una Nueva Especie del Género *Monophyllanthe* (Marantaceae) de la Cuenca Amazónica

Stella Suárez
Instituto Amazónico de Investigaciones Científicas-SINCHI, Apartado 034174, Bogotá, D.C., Colombia

Gloria Galeano
Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Apartado 7495, Bogotá, D.C., Colombia

Helen Kennedy
Herbarium, Botany Department, University of British Columbia, Vancouver, BC V6T 1Z4, Canada

Resumen. Se describe e ilustra una nueva especie del género *Monophyllanthe, M. araracuarensis* S. Suárez, Galeano & H. Kennedy (Marantaceae) de la Amazonia colombiana y la brasileña adyacente. Esta es la segunda especie descrita para el género, previamente conocido solo de Guyana Francesa y Surinam. La nueva especie se distingue principalmente por su inflorescencia esparcidamente ramificada, con 3 a 7 brácteas por rama, producida en un brote sin hojas que sale directamente del rizoma.

Abstract. A new species of *Monophyllanthe, M. araracuarensis* S. Suárez, Galeano & H. Kennedy (Marantaceae) from Amazonian Colombia and adjacent Brazil, is described and illustrated. This is the second species described in the genus, which was previously known only from French Guiana and Suriname. The new species is characterized by its sparsely branched inflorescence, with 3 to 7 bracts per branch, borne on a separate, leafless shoot directly from the rhizome.

Key words: Brazil, Colombia, Marantaceae, *Monophyllanthe.*

El género *Monophyllanthe* fue descrito por Schumann (1902), con base en ejemplares de la Guyana Francesa, y hasta ahora era conocido solo por la especie *M. oligophylla* K. Schumann. La segunda especie del género, representada por material colectado en la Amazonia colombiana y brasileña, se describe a continuación.

Monophyllanthe araracuarensis S. Suárez, Galeano & H. Kennedy, sp. nov. TIPO: Colombia. Amazonas: río Caquetá, margen sur, Peña Roja, 0°39′S, 72°05′W, ca. 200 m, 9 jun. 1991, *G. Galeano, X. Martínez & S. Suárez 2767* (holótipo, COAH; isótipos, COL, MO, UBC). Figura 1.

Planta caespitosa usque ad 150 cm alta; caules pluries 1- raro 2-folio. Folia basalia; lamina oblonga sublineari anguste obovata vel ovata, 21–55 × 3.2–8.0 cm, acuminata vel acuta, basi angustata vel cuneato-angustata. Inflorescentia ex (2 vel)3 ad 5 ramis filiformibus laxis; scapo hypogaeo 6–17 cm longo; bracteis (3 vel)4 ad 7 angustis, rosis. Flores albi; staminodis exteris 2, dissimilibus (15 × 6 mm et 6 × 3 mm), calloso usque ad 7 mm longo, cucullato 5–6 mm longo, appendice complanato basali munito.

Cespitosa, con 3–11 brotes, generalmente en línea, formando matas frondosas de 54–150 cm alto, cada brote con una, o más raramente, con dos hojas basales. Catafilos 11–25 cm, apiculados, rojo-púrpura oscuro cuando jóvenes, la superficie áspera a tomentosa, con verrugas pequeñas. Hoja con vaina no auriculada o raramente auriculada, de 8.5–25.8 cm, tomentosa o esparcidamente pilosa, casi lisa o cubierta con pequeñas verrugas; pecíolo 7.5–87.7 cm, verde, tomentoso a esparcidamente piloso, con pequeñas verrugas a veces muy esparcidas; pulvínulo 0.5–1.8 cm, articulado, casi dos veces el diámetro del pecíolo, verde, tomentoso adaxialmente o lateralmente a casi glabro; lámina oblonga a casi linear o estrechamente obovada u ovada, con el ápice agudo o acuminado, la lámina céntrica, la base atenuada o cuneado-atenuada, 21–55 × 3.2–8 cm, por la haz verde, pilosa hacia el ápice, el resto glabro, el nervio medio verde-amarillento, piloso,

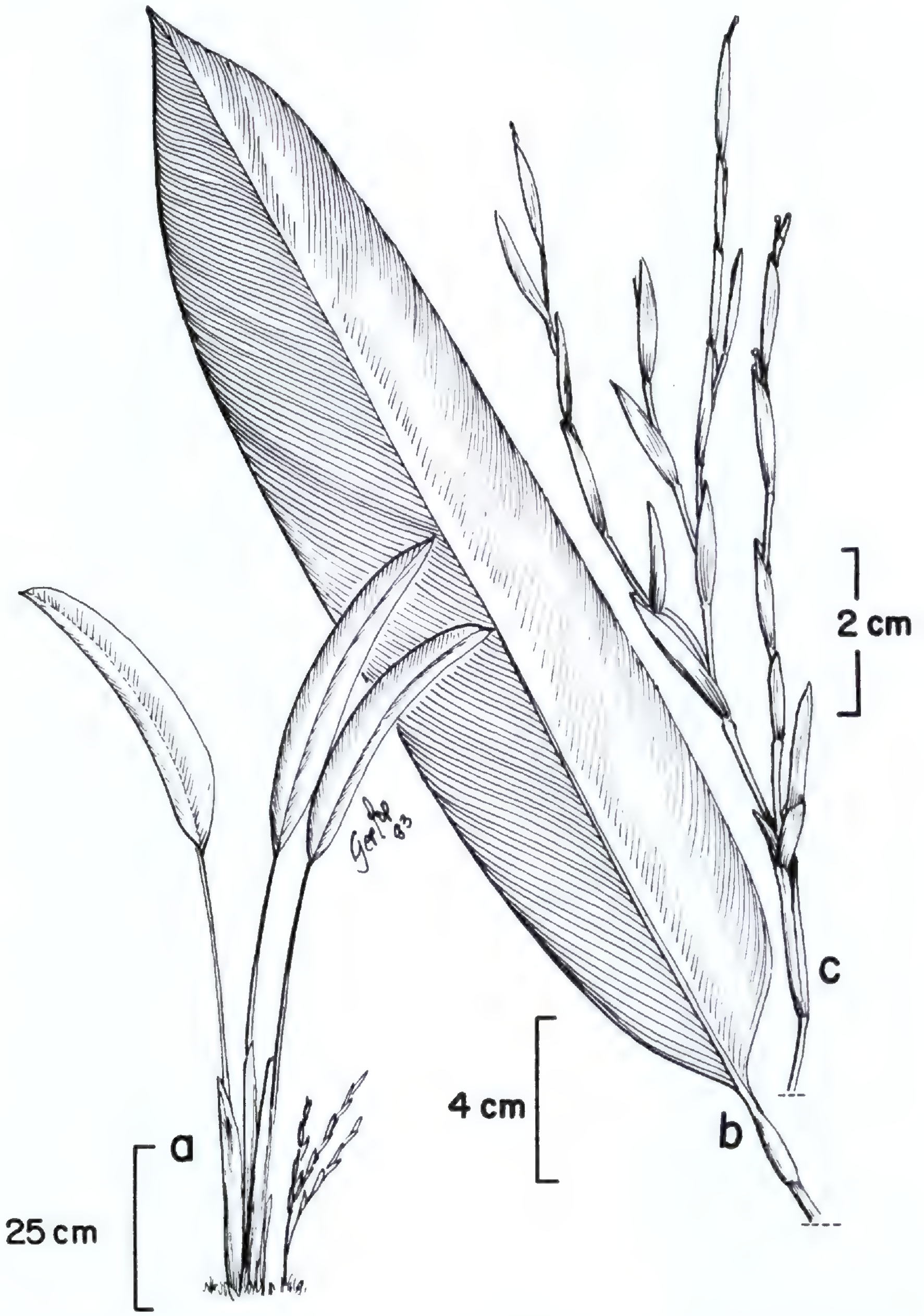


Figura 1. *Monophyllanthe araracuarensis* S. Suárez, Galeano & H. Kennedy. —a. Hábito. —b. Lámina. —c. Detalle de la inflorescencia, con el pedúnculo removido. (De *Galeano et al. 2767.*)

envés verde-grisáceo, la superficie con pequeñas verrugas, en seco con una banda marginal de ca. 1 cm ancho (en uno de los lados) de color café más oscuro que el resto de la superficie, el ápice y a veces toda la banda o solo las márgenes densamente tomentosos, el resto glabro, el nervio medio verde-amarillento. Inflorescencia originada de un brote sin hojas que sale directamente del rizoma, sub-erecta o postrada, con parte del escapo enterrado, de tal manera que la inflorescencia surge a la superficie del suelo algo alejada del resto de la planta, esparcidamente ramificada, con (2)3 a 5 ramas de ejes rojizos, muy delgados hasta casi filiformes pero con los nudos engrosados, los ejes esparcidamente pilosos, de 11–30 cm de largo; escapo 6–17 cm, muy delgado, cubierto con catafilos estrechamente ovados a lineares, obtusos, de 1.2–2.7 × 0.2–0.6 cm, glabros o algunos de los superiores esparcidamente pilosos y con pequeñas verrugas; brácteas (3)4 a 7 por rama, linear-ovadas,

obtusas o agudas, 1.5–2.5 × 0.4 cm, glabras, exceptuando el ápice piloso, rojizas, y cada una subtendiendo 1 ó 2 pares de flores; profilo bicarinado, linear, agudo, 8–20 × 1 mm, glabro o esparcidamente piloso; interfilos ausentes; bracteolas ausentes; pedicelo común 14–22 mm, piloso; pedicelo largo 5–6 mm; pedicelo corto ca. 1 mm, los pedicelos individuales densamente pilosos; sépalos lineares, agudos, 4–7 × 1 mm, esparcidamente pilosos; tubo de la corola 4 mm de largo, 1 mm de diámetro, lóbulos elípticos, agudos, 4–12 × 1–2 mm, blancos, glabros; estaminodios exteriores 2, de diferente tamaño, delicados, uno de 15 × 6 mm y otro de 6 × 3 mm, blancos; estaminodio calloso 7 × 3 mm, blanco, con callosidad basal; estaminodio cuculado obovado-oblongo, con el ápice truncado-mucronado, 5–6 × 1–2 mm, amarillo, con un apéndice basal pequeño y aplanado; ovario 1–2 × 1–3 mm, seríceo, el estilo amarillo. Frutos elípticos, acanalados, 5 × 3 mm, verdosos a púrpura oscuro.

Distribución y hábitat. Conocida solo en dos localidades en el Suroriente de la Amazonia colombiana y un área cercana de la Amazonia brasileña, en áreas de bosque Húmedo Tropical, sobre tierra firme, en terrazas, a elevaciones por debajo de 300 m. En la localidad de Araracuara (Medio río Caquetá, Colombia), *M. araracuarensis* era la especie dominante en el sotobosque de tierra firme (Suárez & Galeano, 1996).

Etimología. El epíteto específico alude a la región de Araracuara, en la Amazonia colombiana, en donde se colectó el espécimen tipo.

Discusión. Monophyllanthe araracuarensis es la segunda especie del género. La otra especie, *M. oligophylla,* conocida de la Guyana Francesa y de Surinam (Andersson, 1981; Jonker-Verhoef & Jonker, 1957), se diferencia principalmente por que la inflorescencia se origina de un brote folioso, es corta (5–16 cm de largo), no tiene ramas, y lleva solo 3 a 4 brácteas (Schumann, 1902), en contraste con la inflorescencia de *M. araracuarensis* la cual se origina de un brote separado, no folioso, alcanza 15–30 cm de largo y es ramificada con (2)3 a 5 ramas, cada una con 3 a 7 brácteas. Además, *M. oligophylla* es más pequeña (hasta 35 cm de alto), con láminas de 11–16 × 2.5–5.5 cm (Jonker-Verhoef & Jonker, 1957) y partes florales más largas: sépalos 5–8 mm de largo y tubo de la corola ca. 8 mm de largo (Schumann, 1902). En contraste, la nueva especie es más grande (54–150 cm alto), con láminas más largas y angostas (21–55 × 3.2–8 cm), y partes florales más cortas: sépalos 4–7 mm de largo y tubo de la corola hasta 4 mm de largo. Se encontró cierta variación entre el material de Araracuara (el holótipo) y el de la frontera Colombo-brasileña (los parátipos) en cuanto al indumento del pulvínulo y de la banda marginal: en los parátipos el pulvínulo es casi glabro y la banda marginal es tomentosa, mientras que en el material de Araracuara, el pulvínulo es densamente tomentoso y la banda marginal es casi glabra.

El hallazgo de *M. araracuarensis* constituye el primer registro de este género en Colombia y Brasil, y plantea una disyunción en la distribución del género. Además, aporta elementos de discusión para la posición del género dentro de la familia. Andersson (1981, 1998), en su discusión sobre la delimitación de los géneros neotropicales de marantáceas, sugirió que el género *Monophyllanthe,* junto con el género *Maranta,* del cual difícilmente se diferencia, conforman el grupo natural *Maranta,* caracterizado por poseer inflorescencias con ejes delgados y alargados, ausencia de interfilos y bracteolas muy pequeñas o ausentes. El género *Monophyllanthe* fue establecido por Schumann (1902) como un género independiente de *Maranta,* con base en el hábito, caracterizado por tener solo una o dos hojas, y por tener solo un estaminodio exterior. Andersson (1981) observó en *M. oligophylla* que era frecuente también la presencia menos consistente de dos estaminodios exteriores (uno de ellos más pequeño que el otro). En *M. araracuarensis* es clara la presencia de dos estaminodios exteriores. Por otro lado, la estructura de las flores en *M. araracuarensis* es más similar a la de las especies de *Maranta* subgénero *Koernickea, Calatheastrum* y *Friedrichsthalia* que a las del subgénero *Maranta.*

Los géneros del grupo *Myrosma* (*Ctenanthe, Hylaenthe, Myrosma, Saranthe* y *Stromanthe*) tienen también dos estaminodios exteriores (Andersson, 1998). Es claro, sin embargo, que *M. araracuarensis* no pertenece a este grupo, porque el hábito con una a dos hojas por brote es raro en el grupo *Myrosma.* Además, las brácteas del grupo *Myrosma* son dísticas con simetría dorsi-ventral, aunque las flores están arregladas a un lado de la inflorescencia. En la especie nueva las brácteas no tienen simetría dorsi-ventral y las flores están dispuestas a ambos lados de los ejes de la inflorescencia, como ocurre en *Maranta* y *Monophyllanthe.*

Por otra parte, en cuanto a la estructura floral, *M. araracuarensis* es más similar a *Maranta leuconera* E. Morren que a las especies del grupo *Myrosma,* en las cuales el estilo sobresale más allá del tubo de la corola y el movimiento, con relación con el polinizador, se dá en el plano vertical, mientras que en las especies del grupo *Myrosma* (excepto en

Hylaenthe), el estilo no sobresale sino que está al mismo nivel del tubo de la corola, haciendo que el movimiento del polinizador se dé en el plano horizontal. Además, las brácteas tan delgadas y firmes de *M. araracuarensis* son más similares a las de *Monophyllanthe* que a las de *Maranta.*

Determinar si *Maranta* y *Monophyllanthe* son realmente un sólo género, necesitaría un estudio más profundo; en cualquier caso, el hallazgo de esta nueva especie aportará elementos claves en esta discusión.

Paratipos. BRASIL. **Amazonas:** Tabatinga trail NE from Colombian border at Leticia, ca. 120 m, 13 Mar. 1977, *A. Gentry & D. Daley 18248* (UBC). COLOMBIA. **Amazonas:** Leticia, finca Misiones, 8 km out of Leticia on road past airport, rain forest on N side of road, 11 Feb. 1971, *H. Kennedy 826* (COL, MO, UBC); Leticia, 8 km along road past airport, near Vega's finca, in rainforest on left side of road, 7 Feb. 1972, *H. Kennedy & R. Andrews 1351* (COL, MO, UBC).

Agradecimientos. El material de Araracuara se colectó durante un inventario de las Marantaceae de esa región, como parte del proyecto Flora del Medio Caquetá, apoyado por la Fundación Tropenbos-Colombia, el Instituto Amazónico de Investigaciones Científicas-Sinchi (antiguamente Corporación Araracuara) y el Instituto de Ciencias Naturales de la Universidad Nacional de Colombia. G. López realizó la ilustración; el Padre Ortíz y B. L. Burtt ayudaron con la descripción latina y L. Andersson, R. Bernal y M. Newman hicieron valiosos comentarios al manuscrito.

Literatura Citada

Andersson, L. 1981. The neotropical genera of Marantaceae. Nordic J. Bot. 1: 218–245.

———. 1998. Marantaceae. *In:* Kubitzki et al. (editors), The Families and Genera of Vascular Plants 3: 278–293. Springler-Verlag, Berlin.

Jonker-Verhoef, A. M. E. & F. P. Jonker. 1957. Marantaceae. *In:* A. A. Pulle & J. Lanjouw (editors), Flora of Surinam 1: 149–208.

Schumann, K. 1902. Marantaceae. *In:* A. Engler & W. Engelman (editors), Das Pflanzenreich IV. 48: 1–189.

Suárez, S. & G. Galeano. 1996. Las Marantáceas de la Región de Araracuara. Estudios en la Amazonia colombiana, Vol 10. Fundación Tropenbos-Colombia, Impreandes Presencia, Bogotá.

New Combinations in the Florida Flora

Daniel B. Ward
Department of Botany, University of Florida, Gainesville, Florida 32611, U.S.A.

ABSTRACT. New combinations are made for the following species and varieties within the flora of Florida: *Agaloma oerstediana, Agaloma pubentissima, Aristida stricta* var. *beyrichiana, Asimina spatulata, Deeringothamnus rugelii* var. *pulchellus, Erianthus brevibarbis* var. *contortus, Ludwigia curtissii* var. *simpsonii, Nyssa biflora* var. *ursina, Pentalinon luteum* var. *sericeum, Peperomia humilis* var. *cumulicola, Ptelea trifoliata* var. *baldwinii, Stipulicida setacea* var. *filiformis, Zamia floridana* var. *umbrosa.*

Key words: *Agaloma,* Annonaceae, Apocynaceae, *Aristida, Asimina,* Caryophyllaceae, *Deeringothamnus, Erianthus,* Euphorbiaceae, Florida, *Ludwigia,* North America, *Nyssa,* Nyssaceae, Onagraceae, *Pentalinon, Peperomia,* Piperaceae, Poaceae, *Ptelea,* Rutaceae, *Stipulicida, Zamia,* Zamiaceae.

Florida possesses one of the richest floras in number of species of any state in the U.S., exceeded only by California and Texas. This abundance extends to its infraspecific taxa—the varieties and subspecies—and is surely due to the relative isolation of the peninsular body of the state from the continental landmass, and the endemism that has followed interglacial flooding and the resultant populational disjunctions.

This profuse and intricate flora has yet to receive the detailed study and understanding regularly accorded the floras of many states in the western and northeastern United States, though recent guides (Clewell, 1985; Wunderlin, 1998) are significant efforts in that direction. Monographs, especially, are prone to gloss over taxa in Florida that appear of secondary importance, and when placing Florida species in new generic classifications, often fail to transfer varieties and subspecies that are readily recognizable to Florida field botanists.

The following new combinations provide names for a few of the orphan taxa that have been recognized historically in Florida but for one reason or another presently have no legitimate name in the appropriate genus or species. In each of these transfers, earlier authors have treated the taxon as worthy of recognition; no new taxa are proposed. These taxa are also accepted here, as clearly distinguishable components of the Florida flora. Where generic realignments have been proposed and are here accepted, acknowledgment is thereby given to the merit of those changes.

Though the *International Code of Botanical Nomenclature* (Greuter et al., 2000) permits both subspecies and variety to be employed as infraspecific ranks, the writer's past experience has shown few if any situations where both of these two hierarchical ranks are needed. The far greater historic seniority of variety over subspecies, the clear intermediacy of variety between species and form, and the flavor of calculated erudition attached to subspecies, seem sufficient to justify variety for the infraspecific combinations created here.

ANNONACEAE

Asimina spatulata (R. Kral) D. B. Ward, comb. et stat. nov. Basionym: *Asimina longifolia* R. Kral var. *spatulata* R. Kral, Brittonia 12: 266. 1960. TYPE: U.S.A. Florida: Leon Co., abundant in recently burned sandy pine flatwoods, 1 mi. NW Lake Jackson, 7 May 1957, *Kral 4714* (holotype, NY; isotypes, BH, BM, DUKE, F, FLAS, FSU, GA, GH, IA, MIAMI, MO, NA, NCSC, NCU, PH, UC, US).

Kral (1960) interpreted the familiar Florida Dog Banana to consist of two taxa, which he separated as *Asimina longifolia* var. *longifolia,* and *A. longifolia* var. *spatulata.* He found ranges of the two entities to be largely allopatric, supported by a number of leaf, flower, pubescence, and habit differences. Wilbur (1970) was not convinced that these taxa merited recognition even at varietal level. The distinctions as described by Kral, however, do appear consistent in Florida populations, above that normally accorded varietal status. Recognition of *A. spatulata* at the specific level seems justified.

Deeringothamnus rugelii (B. L. Robinson) J. K. Small var. **pulchellus** (J. K. Small) D. B. Ward, comb. et stat. nov. Basionym: *Deeringothamnus pulchellus* J. K. Small, Bull. Torrey Bot. Club 51: 390. 1924. TYPE: U.S.A. Florida: Desoto Co., pinelands, uninhabited wilderness E of Punta Gorda, 28 Apr. 1923, *Small 10925* (holotype, NY; isotypes, GH, MCU, MICH, MO).

Deeringothamnus has been known as a ditypic genus endemic to Florida, with a yellow-flowered species (*D. rugelii*) restricted to Seminole and Volusia Counties, east-central Peninsula, and a white-flowered species (*D. pulchellus*) in Lee and Charlotte Counties, southwest Peninsula (Kral, 1960). A collection by O'Neill from Bithlo, Orange County, central Peninsula (noted by Kral, but misattributed to Moldenke), and several recently discovered populations near Orlando, Orange County, seem intermediate. An Orlando population found in 1985 has been assigned to the white-flowered taxon (Eliane M. Norman, pers. comm., June 1987). Though flower color is not the only distinguishing character (petal shape and degree of curvature differ also), the presence of intermediates suggests a fragmented ancient population differing in random ways and better treated as a single species.

APOCYNACEAE

Pentalinon luteum (L.) B. Hansen & R. Wunderlin var. **sericeum** (R. W. Long) D. B. Ward, comb. nov. Basionym: *Urechites lutea* (L.) N. L. Britton var. *sericea* R. W. Long, Rhodora 72: 31. 1970. TYPE: Haiti. Tortue Island, vicinity of La Valle, thicket E of harbor, twining on shrubs to height of 15 ft., flowers yellow, 28 Dec. 1928, *Leonard 11642* (holotype, GH).

Once known as *Urechites* Mueller Argoviensis, this small genus (apparently 2 species) is correctly termed *Pentalinon* Voigt (Hansen & Wunderlin, 1986; accepted by Howard, 1989). Although in the Antilles *Pentalinon luteum* has been described as glabrous to variously pubescent (Howard, 1989), the founder effect selections represented in Florida, as reported by Small (1933), appear sufficiently distinct to merit retention of two entities at varietal rank.

CARYOPHYLLACEAE

Stipulicida setacea A. Michaux var. **filiformis** (G. V. Nash) D. B. Ward, comb. et stat. nov. Basionym: *Stipulicida filiformis* G. V. Nash, Bull. Torrey Bot. Club 22: 148. 1895. TYPE: U.S.A. Florida: Lake Co., dry sandy soil, vicinity of Eustis, 12–31 Mar. 1894, *Nash 14* (holotype, NY).

As do so many other widespread southeastern species, *Stipulicida setacea* shows increasing variability in the part of its range that extends into peninsular Florida. This variability was acknowledged long ago by Nash (1895) in recognizing *S. filiformis* from Lake County, central Peninsula. James (1957), though unwilling to distinguish *S. filiformis* from typical *S. setacea*, noted and named (as *S. setacea* var. *lacerata* C. W. James) a variant with strikingly lacerate sepals from Pinellas County, on the Gulf Coast. These variations have been carefully observed and recorded by Judd (1983: 36); he found recognition of the lacerate-sepaled variant justified at varietal level, though he conservatively concluded the slender-stemmed *S. filiformis* "merely represents a morphological/ecological extreme" of typical *S. setacea*. However, since Judd's map and other data place Nash's *S. filiformis* almost exclusively within the elongate Central Florida Ridge, home of a host of other Florida endemics (Christman & Judd, 1990), loss of all taxonomic recognition for this plant would be unfortunate. Varietal status preserves the taxon, yet reflects its modest and intergrading morphological differences.

EUPHORBIACEAE

Agaloma oerstediana (J. F. Klotzsch & C. A. Garcke) D. B. Ward, comb. nov. Basionym: *Poinsettia oerstediana* J. F. Klotzsch & C. A. Garcke, Monatsber. Konigl. Preuss. Akad. Wiss. Berlin 1860: 103. 1860 (holotype, B perhaps no longer extant).

Agaloma oerstediana was first reported for Florida (as *Euphorbia graminea* Jacquin) by Herndon (1994), based on several collections in Dade County, the southernmost tip of the Peninsula, where it has become a frequent greenhouse weed. It has since moved via horticultural transplants into landscape settings northward at least to Palm Beach County. Its white-appendaged glands clearly mark it as a member of *Euphorbia* subg. *Agaloma* as conventionally delimited (Webster, 1967). (Corrected identification of the Florida introduction has been supplied by Daniel F. Austin and Derek Burch, with Richard Abbott adding data as to recent distribution.)

The genus *Euphorbia*, broadly circumscribed (Boissier, 1862, 1866; Pax & Hoffmann, 1931), consists of over 1500 species, a vast assembly held together by the presence of a bisexual pseudanthium or cyathium. Recent workers (Webster, 1994) have somewhat reduced this unwieldy grouping by recognition of small segregate genera (notably *Pedilanthus* and *Chamaesyce*), but authors who have made major generic dissections on the basis of gross morphology or other non-cyathial characters have in general been disregarded or their taxa retained only at infrageneric rank (cf. Wheeler, 1943; Webster, 1967, 1994; Govaerts et al., 2000).

It is difficult to understand why these infrage-

neric taxa, some of them sharply differentiated, are so seldom given generic ranking; perhaps the unique structure of the cyathium overrides acknowledgment of other, conflicting criteria. In any event, in the belief that certain of these segregate groupings more closely represent what may be elsewhere interpreted to be of generic rank than does the undivided cyathial complex, it is believed appropriate, at least for the purpose of regional floristic analysis, to recognize *Agaloma* Rafinesque at generic level. (Equivalent status is to be given to *Chamaesyce* S. F. Gray, *Poinsettia* Graham, and *Tithymalus* Gaertner (Ward, ms.). *Euphorbia* s. str. has no native or naturalized species in North America.)

Agaloma pubentissima (A. Michaux) D. B. Ward, comb. nov. Basionym: *Euphorbia pubentissima* A. Michaux, Fl. Bor. Amer. 2: 212. 1803. TYPE: U.S.A. Carolina: *Michx. s.n.* (holotype, P).

The impressive, yet unpublished, thesis by Huft (1979) documented this species as occurring widely in the southeastern United States and sparingly in north Florida. It was addressed by Small (1933) as *Tithymalopsis apocynifolia* (Small) Small, *T. paniculata* (Elliott) Small, and *T. zinniiflora* Small.

GRAMINEAE (= POACEAE)

Aristida stricta A. Michaux var. **beyrichiana** (C. B. von Trinius & F. J. Ruprecht) D. B. Ward, comb. et stat. nov. Basionym: *Aristida beyrichiana* C. B. von Trinius & F. J. Ruprecht, Mem. Acad. St. Petersb. VI. Sci. Nat. 7(2): 104. 1849. TYPE: U.S.A. Georgia?, in pinetis, *Beyrich s.n.* (holotype, LE; isotype, US).

Peet (1993) has reported that the familiar Wiregrass consists of two populations separable on pubescence of the leaf sheaths, the typical, near-glabrous one native to eastern North Carolina and adjacent South Carolina, and the second to southern South Carolina, Georgia, and Florida. Peet matched the more pubescent southern population with the name *A. beyrichiana* and accorded it specific rank. Standing alone, the stated morphological differences would attract little attention. His supporting argument, that there may have been two main centers of glacial-time persistence of the pineland flora, is of unsupported validity. The modest differences observed in the two Wiregrass populations are of a different order of magnitude from those of the distinct species cited by Peet as endemic to the two areas. Taxonomic recognition does appear justified, but at infraspecific rank.

Erianthus brevibarbis A. Michaux var. **contortus** (W. Baldwin ex S. Elliott) D. B. Ward, comb. et stat. nov. Basionym: *Erianthus contortus* W. Baldwin ex S. Elliott, Sketch 1: 40. 1816. TYPE: U.S.A. Georgia: Savannah, *Baldwin s.n.* (holotype, CHARL now lost).

Webster and Shaw (1995) have argued persuasively that Fernald (1943) was incorrect in his interpretation that Michaux's type of *Erianthus brevibarbis* from Illinois is specifically distinct from southeastern plants; they believed varietal status is sufficient. But if Webster and Shaw's further conclusion that *Erianthus* should be merged with *Saccharum* is rejected, this new combination is needed.

NYSSACEAE

Nyssa biflora T. Walter var. **ursina** (J. K. Small) D. B. Ward, comb. et stat. nov. Basionym: *Nyssa ursina* J. K. Small, Torreya 27: 92. 1927. TYPE: U.S.A. Florida: Gulf Co., Apalachicola River delta, near Port St. Joe, pineland swamps, 27 Nov. 1923 (fr), *Small 10995*, 24 Apr. 1924 (fl), *Small 11233* (syntypes, both NY).

Godfrey (Kurz & Godfrey, 1962; Godfrey, 1988; pers. comm., Dec. 1989) stated his belief that *N. ursina* is a fire-induced form of *N. biflora* (which he treated, 1988, as a variety of *N. sylvatica*). However, Burckhalter (1992) has viewed *N. ursina* as sufficiently distinct in habit, leaf size, and fruit shape to justify recognition at specific rank. While the morphological differences, particularly the stunted form of the plants, are apparent in the field, one is unable to dismiss the possibility that all one is seeing is an environmental response. However, the similarity of range of the Dwarf Tupelo to a wide array of wetland Panhandle endemics suggests a genetic component and tilts the balance toward a median level of taxonomic recognition.

ONAGRACEAE

Ludwigia curtissii A. W. Chapman var. **simpsonii** (A. W. Chapman) D. B. Ward, comb. et stat. nov. Basionym: *Ludwigia simpsonii* A. W. Chapman, Fl. South. U. S., 2nd ed, suppl. 2: 685. 1892. TYPE: U.S.A. Florida: Manatee, low ground, *Simpson s.n.* (holotype, US; isotypes, GH, MO, US).

Peng (1989) looked carefully at the *Ludwigia curtissii–L. simpsonii* complex and its near relatives and concluded the present taxa represent two spe-

cies. To Godfrey and Wooten (1981) the differences had not merited even varietal recognition. Peng agreed the entities are sympatric throughout central and south peninsular Florida (with *L. simpsonii* extending into north Florida), and often intergrade in diagnostic capsule and leaf characters. Peng noted the two taxa to appear to be ecologically distinct, with *L. curtissii* on black muck or in deep standing water, and *L. simpsonii* on roadsides or moist sandy soil. He found *L. curtissii* to be octoploid, *L. simpsonii* to be hexaploid, and the chromosome number to correlate with capsule size (*L. curtissii* the larger). These populational characteristics are undoubtedly as described by Peng. But, setting aside the chromosomal information, the pervasive morphological intergradation confounds the field botanist and guarantees erratic herbarium identifications. Varietal status reflects the small magnitude of apparent differences, yet preserves the taxon.

PIPERACEAE

Peperomia humilis A. G. Dietrich var. **cumulicola** (J. K. Small) D. B. Ward, comb et stat. nov. Basionym: *Peperomia cumulicola* J. K. Small, J. New York Bot. Gard. 22: 197. 1921. TYPE: U.S.A. Florida: Volusia Co., shell-midden, 10 mi. S of Daytona, 30 Nov. 1919, *Small 9196* (holotype, NY).

Florida field botanists stubbornly maintain that Boufford (1982) combined two distinct entities by his treatment of *Peperomia humilis*. The one—always terrestrial, seemingly always on aboriginal shell middens, with leaves round-tipped and spatulate or the lower ones acute, the stems green and sparingly pubescent—is found on scattered sites in northern peninsular Florida, from Fort George Island, Duval County (where locally so common that it forms the dominant ground cover) and Pineola, Citrus County, south at least to Jonathan Dickinson State Park, Martin County. The other—apparently always epiphytic, often on dead limbs, with leaves elliptic and acute, the stems usually pink and densely pubescent—is largely restricted to the Florida Keys and Cape Sable, Monroe County, and the Fakahatchee Strand of Collier County. The differences extend to cultural experiences, with the northern entity successfully grown in Broward County, where the more southern form does not survive. (These observations, together with those of the present author, are the synthesis of long Florida field experience by Daniel F. Austin, John Beckner, Donald Blake, and Roger Hammer.)

The second, more tropical taxon observed in Florida seems clearly the widespread West Indian species known as *Peperomia humilis*, as reported by Boufford. The first, more northern population has long been recognized as distinct under the names *Piper leptostachyon* Nuttall (1822: 287), *Peperomia leptostachya* (Nuttall) Chapman (1883), *Peperomia cumulicola* Small (1921: 197), and *Micropiper leptostachyon* (Nuttall) Small (1933: 400). (For full synonymy, see Boufford, 1982.) Nuttall's *Piper leptostachyon* far predated Small's *Peperomia cumulicola*, but the transfer of *Piper leptostachyon* to *Peperomia* by Chapman (1883) was rendered invalid, as a later homonym, by the earlier formation of *Peperomia leptostachya* Hooker & Arnott (1841) of the Hawaiian Islands. Though at an infraspecific level either epithet is available, the uncertainty that attends the relationship between these two entities clearly leaves open the possibility they will again be treated at specific rank, and use of the same epithet at all ranks is desirable.

RUTACEAE

Ptelea trifoliata L. var. **baldwinii** (Torrey & A. Gray) D. B. Ward, comb. et stat. nov. Basionym: *Ptelea baldwinii* Torrey & A. Gray, Fl. N. Amer. 1: 215. 1838. TYPE: U.S.A. Florida: Duval Co., Fort George Island, *Baldwin s.n.* (holotype, PH).

Florida plants of *Ptelea trifoliata* have been assigned to variety *trifoliata*, variety *mollis* Torrey & A. Gray, and a narrow-leaflet variant that Bailey (1962) left unnamed but with collections from the type locality of *P. baldwinii* (Fort George Island, Duval County, Florida). Bailey, in a continuation of her study (Bailey et al., 1970), found plants with "narrow terminal leaflets" in 11% of populations within the Florida peninsula, but none elsewhere in the Southeast. Small (1933), though treating it at specific rank, well described and provided a key to set apart the narrow-leaflet population. Other authors (Godfrey, 1988; Wunderlin, 1998) have been unwilling to recognize any named infraspecific entities. But the morphological differences as confirmed by Bailey, though modest, have reasonably discrete ranges, and merit at least minimal taxonomic recognition.

ZAMIACEAE

Zamia floridana A. P. DC. var. **umbrosa** (J. K. Small) D. B. Ward, comb. et stat. nov. Basionym: *Zamia umbrosa* J. K. Small, J. New York Bot. Gard. 22: 136. 1921. TYPE: U.S.A. Florida: Volusia Co., hammock between Volusia and Ocean City, 4 May 1921, *Small 8679* (lectotype, designated by Eckenwalder (1980), NY; isolectotypes, DUKE, FLAS, GH).

Within Florida two morphologically recognizable races of *Zamia* may be distinguished, the individuals of which retain their differences under uniform culture: the widespread *Z. floridana* and the more restricted east coast *Z. umbrosa*. [From 1962 through 1972, 29 plants from five populations (four of *Z. floridana*, one of *Z. umbrosa*) were maintained under glass in Gainesville, and periodically measured. Both in leaflet orientation and length/width ratios, plants of *Z. umbrosa* (from Flagler County) remained distinct, while those from other localities were indistinguishable both within and among populations.] Even so, both Florida representatives are undoubtedly "founder effect" chance selections from a morphologically varied Caribbean complex. Eckenwalder (1980: 323) made no provision for taxonomic recognition of the differences within the complex, stating: "No coherent system of varieties could be devised that was not . . . arbitrary and . . . typological. . . . Local botanists are thus left with the somewhat unsatisfactory circumstance of not being able to give taxonomic recognition to distinctive variants that occur in their region. . . ." Since not all local botanists are content to be so constrained, varietal status is here proposed for *Zamia umbrosa*. Beyond these two varieties, the extreme narrow-leaflet form of the Dade County rocklands, as well as plants from Putnam and Clay Counties locally known as the Palatka Giant (with leaves to 1.5 m), are yet to be integrated into a conventional nomenclatural structure.

Eckenwalder (1980), relying heavily on leaflet width and vein number, extended *Zamia pumila* L., a name initially applied to plants from Hispaniola, to all members of the genus in the West Indies and Florida. Stevenson (1987), by incorporating leaflet shape and denticulation and cone shape and color, was able to distinguish six species within this area, one of which (his *Z. integrifolia*) ranges to Florida; he later (1991) examined the genus as found in the United States in satisfying detail. Landry (1993) has followed Stevenson in recognizing the Florida plant as specifically distinct from the all-inclusive *Z. pumila* of Eckenwalder. However, Eckenwalder (pers. comm., Sep. 1977), though he did not himself use the name, appears to have been the first to note the familiar *Zamia integrifolia* Aiton was nomenclaturally superfluous when published, and is thus illegitimate; the Florida segregate, if recognized at specific rank, is *Z. floridana* A. DC.

Acknowledgments. I thank D. E. Boufford, W. S. Judd, C.-I. Peng, K. D. Perkins, G. L. Webster, R. L. Wilbur, and R. P. Wunderlin for their suggestions in review of this paper, many others (some acknowledged in the above text) for their generosity in sharing field information, and the curators of the New York Botanical Garden for the loan of specimens critical to this study.

Literature Cited

Bailey, V. L. 1962. Revision of the genus *Ptelea* (Rutaceae). Brittonia 14: 1–45.

———, S. B. Herlin & H. E. Bailey. 1970. *Ptelea trifoliata* ssp. *trifoliata* (Rutaceae) in deciduous forest regions of eastern North America. Brittonia 22: 346–358.

Boissier, E. 1862, 1866. Subordo Euphorbieae. DC. Prodr. 15(2): 3–188; 1261–1269.

Boufford, D. E. 1982. Notes on *Peperomia* (Piperaceae) in the southeastern United States. J. Arnold Arbor. 63: 317–325.

Burckhalter, R. E. 1992. The genus *Nyssa* (Cornaceae) in North America: A revision. Sida 15: 323–342.

Chapman, A. W. 1883. Fl. South. U.S. Suppl. 645.

Christman, S. P. & W. S. Judd. 1990. Notes on plants endemic to Florida scrub. Florida Sci. 53: 52–73.

Clewell, A. F. 1985. Guide to the Vascular Plants of the Florida Panhandle. Univ. Presses of Florida, Tallahassee.

Eckenwalder, J. E. 1980. Taxonomy of the West Indian cycads. J. Arnold Arbor. 61: 701–722.

Fernald, M. L. 1943. *Erianthus brevibarbis* and other species. Rhodora 45: 246–255.

Godfrey, R. K. 1988. *Nyssa, Ptelea. In:* Trees, Shrubs, and Woody Vines of Northern Florida and Adjacent Georgia and Alabama. Univ. Georgia Press, Athens.

——— & J. W. Wooten. 1981. *Ludwigia. In:* Aquatic and Wetland Plants of Southeastern United States: Dicotyledons. Univ. Georgia Press, Athens.

Govaerts, R., D. G. Frodin & A. Radcliffe. 2000. World Checklist and Bibliography of Euphorbiaceae. Royal Botanic Gardens, Kew 2: 792.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Hansen, B. F. & R. P. Wunderlin. 1986. *Pentalinon* Voigt, an earlier name for *Urechtites* Muell. Arg. (Apocynaceae). Taxon 35: 166–168.

Herndon, A. 1994. *Euphorbia graminea* (Euphorbiaceae) new to Florida. Sida 16: 208–209.

Hooker, W. J. & G. A. Walker Arnott. 1841. Piperaceae. P. 96 *in:* Bot. Beechey Voy. Henry G. Bohn, London.

Howard, R. A. 1989. *Urechites. In:* Flora of the Lesser Antilles 6: 115.

Huft, M. J. 1979. A Monograph of *Euphorbia* section *Tithymalopsis*. Ph.D. Dissertation, University of Michigan, Ann Arbor.

James, C. W. 1957. A new variety of *Stipulicida setacea*. Rhodora 59: 98.

Judd, W. S. 1983. The taxonomic status of *Stipulicida filiformis* (Caryophyllaceae). Sida 10: 33–36.

Kral, R. 1960. A revision of *Asimina* and *Deeringothamnus* (Annonaceae). Brittonia 12: 233–278.

Kurz, H. & R. K. Godfrey. 1962. *Nyssa. In:* Trees of Northern Florida. Univ. Florida Press, Gainesville.

Landry, G. P. 1993. Zamiaceae. *In:* Flora N. America 3: 347–349. Oxford Univ. Press, New York.

Nash, G. V. 1895. Notes on some Florida plants. Bull. Torrey Bot. Club 22: 141–161.

Nuttall, T. 1822. Catalogue of plants growing in east-Florida. Amer. J. Sci. 5: 286–304.

Pax, F. & K. Hoffmann. 1931. Euphorbiaceae. *In:* Nat. Pflanzenfam., ed. 2. 19c: 11–233.

Peet, R. K. 1993. A taxonomic study of *Aristida stricta* and *A. beyrichiana*. Rhodora 95: 25–37.

Peng, C. I. 1989. The systematics and evolution of *Ludwigia* sect. *Microcarpium* (Onagraceae). Ann. Missouri Bot. Gard. 76: 221–302.

Small, J. K. 1921. Historic trails, by land and by water, a record of exploration in Florida in December 1919. J. New York Bot. Gard. 22: 193–222.

———. 1933. *Tithymalopsis, Urechites. In:* Manual of the Southeastern Flora. Published by the author, New York.

Stevenson, D. W. 1987. Again the West Indian zamias. Fairchild Trop. Gard. Bull. 42: 23–27.

———. 1991. The Zamiaceae in the southeastern United States. J. Arnold Arbor., Suppl. Ser. 1: 367–384.

Webster, G. L. 1967. The genera of Euphorbiaceae in the southeastern United States. J. Arnold Arbor. 48: 303–430.

———. 1994. Synopsis of the genera and suprageneric taxa of Euphorbiaceae. Ann. Misouri Bot. Gard. 81: 33–144.

Webster, R. D. & R. B. Shaw. 1995. Taxonomy of the native North American species of *Saccharum* (Poaceae: Andropogoneae). Sida 16: 551–580.

Wheeler, L. C. 1943. The genera of the living Euphorbieae. Amer. Midl. Naturalist 30: 456–503.

Wilbur, R. L. 1970. Taxonomic and nomenclatural observations on the eastern North American genus *Asimina* (Annonaceae). J. Elisha Mitchell Sci. Soc. 86: 88–96.

Wunderlin, R. P. 1998. *Ptelea. In:* Guide to the Vascular Plants of Florida. Univ. Presses of Florida, Gainesville.

Seven New Combinations in the Florida Flora

Richard P. Wunderlin and Bruce F. Hansen
Institute for Systematic Botany, Department of Biology, University of South Florida, Tampa, Florida 33620-5200, U.S.A.

ABSTRACT. Some nomenclatural amendments caused by taxonomic revision in Asteraceae and Poaceae will be adopted for the flora of Florida. Therefore, the new combinations *Carphephorus odoratissimus* var. *subtropicanus* (DeLaney et al.) Wunderlin & B. F. Hansen, *Symphyotrichum carolinianum* (Walter) Wunderlin & B. F. Hansen, *Symphyotrichum sericeum* var. *microphyllum* (DC.) Wunderlin & B. F. Hansen, *Symphyotrichum concolor* var. *plumosum* (Small) Wunderlin & B. F. Hansen, *Dichanthelium nudicaule* (Vasey) B. F. Hansen & Wunderlin, *Urochloa fusca* (Swartz) B. F. Hansen & Wunderlin, and *Urochloa fusca* var. *reticulata* (Torrey) B. F. Hansen & Wunderlin are proposed for Florida taxa.

Key words: Asteraceae, *Carphephorus*, *Dichanthelium*, Florida, North America, Poaceae, *Symphyotrichum*, *Urochloa*.

In the process of preparing a revised edition of the *Guide to the Vascular Plants of Florida* (Wunderlin, 1998), the following four new combinations in the Asteraceae and three in Poaceae were found to be necessary.

ASTERACEAE

Carphephorus odoratissimus (J. F. Gmelin) Hebert var. **subtropicanus** (DeLaney, N. Bissett & Weidenhamer) Wunderlin & B. F. Hansen, comb. nov. Basionym: *Carphephorus subtropicanus* DeLaney, N. Bissett & Weidenhamer, Bot. Explor. 1: 2. 1999. TYPE: U.S.A. Florida: Polk Co., 4.36 mi. E of US Hwy. 27 on Avon Park Cut-off Rd., T32S, R27E, Sec. 21, SE 1/4, 6 Oct. 1999, *N. Bissett 1001* (holotype, USF; isotypes, FLAS, FSU, FTG, GA, NY, USF).

The characteristic fragrant, vanilla-like odor of dried leaves from the common Atlantic and Gulf Coastal plain *Carphephorus odoratissimus* (vanilla-leaf) is produced by the chemical coumarin. It has been noticed by several field botanists that the southern peninsular Florida material usually assigned to this taxon lacks this aromatic feature found in the typical northern form. Small (1933) suggested that there may be two species involved. On the basis of chemistry, morphology, range, and slightly divergent phenology, DeLaney et al. (1999) proposed that the southern Florida plants should be considered as a distinct species, *C. subtropicanus*. Although the presence or absence of coumarin along with the growth habit (*C. subtropicanus* is a generally smaller, more rosulate plant with its inflorescence little-ramified, while the larger, leafy-stemmed *C. odoratissimus* has a much-branched inflorescence) generally separates *C. odoratissimus* from *C. subtropicanus*, there is a slight overlap in morphology, especially in the central peninsula where the ranges of the two species overlap. Also, in consideration of the distinctiveness of the other Florida species of *Carphephorus*, it seems best to treat *C. subtropicanus* at the varietal level.

Representative specimens. U.S.A. **Florida:** Citrus Co., along FL 480, Chassahowitzka, 7 Oct. 1972, *Genelle & Fleming 1606* (USF); Collier Co., off FL 82 W of Immokalee, 25 Sep. 1964, *Lakela 27406* (USF); Hillsborough Co., about 7 mi. NE of University of South Florida Campus, N of Tampa, 15 Oct. 1961, *Lakela 24777* (USF); Martin Co., S of Salerno Junction off US 1 along W side of canal, 29 Sep. 1962, *Lakela 25383* (USF).

ASTER COMPLEX

The genus *Aster* in North America is currently undergoing extensive revision by Luc Brouillet, Guy Nesom, and John Semple. There is some consensus among these workers that the genus *Aster* probably does not occur in North America, but there is uncertainty as to how the North American species should be split up and which generic names apply. For the purposes of the Florida flora, five genera are being recognized: *Aster*, *Doellingeria*, *Ionactis*, *Sericocarpus*, and *Symphyotrichum*. The following three new combinations are needed.

Symphyotrichum carolinianum (Walter) Wunderlin & B. F. Hansen, comb. nov. Basionym: *Aster carolinianus* Walter, Fl. Carol. 208. 1788. *Lasallea caroliniana* (Walter) Semple & Brouillet, Amer. J. Bot. 67: 1023. 1980. *Virgulus carolinianus* (Walter) Reveal & Keener, Taxon 30: 650. 1981. *Ampelaster carolinianus* (Walter) G. L. Nesom, Phytologia 77: 250. 1994 [1995]. TYPE: U.S.A. South Carolina: without locality, s.d., *Herb. Walter s.n.* (holotype, BM photo seen).

The climbing aster has long been considered morphologically unique among the southeastern U.S. asters because of its clambering stems and clasping leaves, and is often recognized as the sole member of a section or subsection. It was first placed in the segregate genus *Lasallea* by Semple and Brouillet (1980) along with 11 other species more widespread in eastern North America. It was then transferred because of nomenclatural priority to the earlier generic name *Virgulus* by Reveal and Keener (1981). Most recently, the taxon was placed in the monotypic genus *Ampelaster* by Nesom (1995), who felt that its unique morphology and chromosome number ($x = 9$) placed it apart from the Virgulus group ($x = 5$). Based on chloroplast DNA evidence (Xiang & Semple, 1996), it is basal within the *Symphyotrichum* clade and seems therefore best included within *Symphyotrichum*.

Representative specimens. U.S.A. **Florida:** Collier Co., Fakahatchee Strand, N of Copeland, 7 Dec. 1974, *Wunderlin et al. 5350* (USF); Columbia Co., Ichetucknee State Park, 3 Nov. 1981, *Correll & Correll 53136* (USF); Hardee Co., 9.5 mi. E of Zolfo Springs at Charlie Creek bridge, 10 Nov. 1978, *Hansen 4892* (USF); Wakulla Co., 5.8 mi. N of St. Marks lighthouse, 8 Nov. 1963, *Ward & Ford 3604* (FLAS, USF).

Symphyotrichum sericeum (Ventenat) G. L. Nesom var. **microphyllum** (DC.) Wunderlin & B. F. Hansen, comb. nov. Basionym: *Aster sericeus* Ventenat var. *microphyllus* DC., Prodr. 5: 233. 1836. TYPE: U.S.A. Texas: "in Mexici dist. orientalis prov. Texas," Nov.–Dec. 1828, *Berlandier 1876* (holotype, G-DC microfiche seen).

Aster pratensis Rafinesque, Fl. Ludov. 67. 1817. *Lasallea sericea* (Ventenat) Greene subsp. *pratensis* (Rafinesque) Semple & Brouillet, Amer. J. Bot. 67: 1022. 1980. *Virgulus pratensis* (Rafinesque) Reveal & Keener, Taxon 30: 649. 1981. *Symphyotrichum pratense* (Rafinesque) G. L. Nesom, Phytologia 77: 290. 1994 [1995]. TYPE: U.S.A. Louisiana.

Aster ciliatus Nuttall, Trans. Amer. Philos. Soc., ser. 2. 7: 295. 1840; non *Aster ciliatus* Walter, Fl. Carol. 209. 1788; nec *Aster ciliatus* Muhlenberg ex Willdenow, Sp. Pl. 3: 2027. 1805. *Aster phyllolepis* Torrey & A. Gray, Fl. N. Amer. 2: 113. 1841. *Lasallea phyllolepis* (Torrey & A. Gray) Greene, Leafl. Bot. Observ. Crit. 1: 5. 1903. TYPE: U.S.A. Louisiana: Collector unknown (holotype, P[Hb. Durand] not seen.)

There is no type specimen for *Aster pratensis* Rafinesque nor for most of the other new names from his *Florula Ludoviciana*. A neotype should be designated, but that is somewhat beyond the scope of this paper.

This southeastern United States taxon has larger heads and less pubescent phyllaries than the typical variety. We follow Hatch et al. (1990) and Wunderlin (1998) in recognizing this entity at the varietal level rather than as a species (as *Symphyotrichum pratense*) as proposed by Nesom (1995), or as a subspecies (as *Lasallea sericea* subsp. *pratensis*) as proposed by Semple and Brouillet (1980).

In his protologue of *Aster ciliatus*, Nuttall cited a Louisiana specimen in the Durand Herbarium in Philadelphia by an unnamed or unknown collector. The herbarium of Elias Durand is now housed at Paris (Pennell, 1936); the type for this name should be sought there.

Representative specimen. U.S.A. **Florida:** Gadsden Co., E side of FL 269, 0.5 mi. S of railroad tracks (River Junction), 5 Oct. 1985, *Gholson 11507* (FLAS).

Symphyotrichum concolor (L.) G. L. Nesom var. **plumosum** (Small) Wunderlin & B. F. Hansen, comb. et stat. nov. Basionym: *Aster plumosus* Small, Bull. Torrey Bot. Club 51: 387. 1924. TYPE: U.S.A. **Florida:** Gadsden Co., Aspalaga, dry sandy soil, Oct. 1897, *Biltmore Herb. 36b* [*Chapman s.n.*] (holotype, NY microfiche seen).

This is distinguished from the autonymic variety of *Symphyotrichum concolor* only by its loosely spreading or recurved phyllaries. It is restricted to the Appalachicola River region of Gadsden, Liberty, Franklin, and Calhoun Counties of Florida, apparently in slightly wetter sites than the autonymic variety, which is common throughout Florida, the southeastern United States, and north along the coast to New York and Massachusetts.

Representative specimens. U.S.A. **Florida:** Calhoun Co., 9 mi. N of the Chipola River near FL 71, 10 Nov. 1962, *Clewell 736* (USF); Liberty Co., Forest Road 180 2 mi. from its jct. with FL 65 S of Wilma, Apalachicola National Forest, 4 Nov. 1987, *Godfrey 82607* (USF); along E side of FL 379, 0–0.3 mi. N of jct. with Forest Road 172, ca. 9 mi. NW of Sumatra and 4.2 air mi. W of Kern, 30°7′55″N, 85°3′20″W, 28 Oct. 1990, *Orzell & Bridges 15682* (USF).

POACEAE

Dichanthelium nudicaule (Vasey) B. F. Hansen & Wunderlin, comb. nov. Basionym: *Panicum nudicaule* Vasey, U.S.D.A. Div. Agrost. Bull. 8: 31. 1889. TYPE: U.S.A. Florida: Santa Rosa Co., swamps, May 1886, *Curtiss 3583** (lectotype, designated by Hitchcock & Chase (1910: 179), US microfiche seen; isolectotypes, NY microfiche seen, TAES not seen, US microfiche seen).

This name was lectotypified by Hitchcock and Chase (1910) by a clear citation of the Curtiss specimen as the type.

Hansen and Wunderlin (1988), in their synopsis of the Florida species of *Dichanthelium*, treated *Panicum nudicale* Vasey as a synonym of the widespread and variable *D. dichotomum* (L.) Gould. We now believe the taxon is distinct from *D. dichotomum*; the new combination is needed to accommodate it in *Dichanthelium*.

This species is found only along a small area of the Gulf Coast from Bay County, Florida, to southeastern Mississippi. It is separable from *Dichanthelium dichotomum* by its wide, ascending, mostly basal leaves and its tufted habit, and also by its habitat preference. According to Kral (1983: 84), it is "most frequent in boggy sites or acidic openings in the titi dominated woods along streams, is on wet peaty or silty sandy substrates that are frequently flooded." The species is listed as threatened in Florida (Florida Administrative Code, chapter 5B–40, 2000).

Representative specimens. U.S.A. **Florida:** Bay Co., between Sand Creek Road and Mule Creek, ca. 8.5 air mi. ESE of Callaway, 9 May 1995, *Anderson 15473* (FSU, USF). **Mississippi:** Rogers Co., Tuxachanie Trail, DeSoto National Forest, 4 May 1974, *Rogers 9537-A* (USF).

Urochloa fusca (Swartz) B. F. Hansen & Wunderlin, comb. nov. Basionym: *Panicum fuscum* Swartz, Prodr. 23. 1788. TYPE: Jamaica. *Swartz s.n.* (types, S not seen).

Urochloa fusca (Swartz) B. F. Hansen & Wunderlin var. **reticulata** (Torrey) B. F. Hansen & Wunderlin, comb. nov. Basionym: *Panicum reticulatum* Torrey, in Marcy, Explor. Red River Louisiana. 299. 1853. *Panicum fasciculatum* var. *reticulatum* (Torrey) Beal, Grasses N. Amer. 2: 117. 1896. *Panicum fuscum* var. *reticulatum* (Torrey) Lamson-Scribner & Merrill, U.S.D.A. Div. Agrost. Circ. 32: 4. 1901. *Brachiaria fasciculata* var. *reticulata* (Torrey) Vickery, Contr. New South Wales Natl. Herb. 4: 250. 1972. TYPE: U.S.A. Texas: main fork of Red River, 3 July 1852, *Marcy Exped. s.n.* (holotype, NY; isotypes, COLO, NY, US-80956 (fragment ex NY)).

The citation of the type of *Panicum reticulatum* Torrey is taken from the on-line Catalogue of New World Grasses (http://mobot.mobot.org/W3T/Search/nwgc.html) where, however, G. G. Shumard is cited as collector. For the two specimens at NY (fide The New York Botanical Garden Vascular Plant Type Catalog [http://www.nybg.org/bsci/hcol/vasc/tflow.html]), R. B. Marcy is given as the collector. Shumard was a geologist on the Marcy Expedition who specialized in fossils (Ewan & Ewan, 1981). Further historical research is necessary to know whether he should be credited with the plant collections from that expedition.

Webster (1987: 235) used the name *Urochloa fasciculata* var. *reticulata* but failed to cite the basionym for either epithet, and thus the combination was invalid. That combination is further untenable because *Panicum fasciculatum* Swartz (Prodr. 23. 1788) cannot be transferred into *Urochloa* due to the existence of *Urochloa fasciculata* Kunth (Enum. Pl. 1: 31. 1833). Therefore, the epithet next in priority must be adopted. Hitchcock and Chase (1951), in the synonymy of *Panicum fasciculatum*, cited three further Swartz names: *Panicum carthaginense* (Prodr. 22. 1788), *P. flavescens* (Prodr. 23. 1788), and *P. fuscum* (Prodr. 23. 1788), all of equal priority. The choice here of *Panicum fuscum* establishes its priority (ICBN, Art. 11.5: Greuter et al., 2000) over the other two names. Full synonymy for the species may be found in Hitchcock and Chase (1951: 916), under *Panicum fasciculatum*.

Representative specimens. U.S.A. **Florida:** Collier Co., Marco Island, vicinity of Marco Pass, 1 May 1965, *Lakela 28526* (USF); Lee Co., Mound Key, Estero Bay, 13 July 1974, *Todd 144* (USF); Volusia Co., 0.4 mi. W of Rte. 3, 8.8 mi. N of Haulover Canal, northern Merritt Island, 24 May 1975, *Shuey s.n.* (USF).

Literature Cited

DeLaney, K. R., N. Bissett & J. D. Weidenhamer. 1999. A new species of *Carphephorus* (Asteraceae; Eupatorieae) from Peninsular Florida. Bot. Explor. 1: 1–15.

Ewan, J. & N. D. Ewan. 1981. Biographical Dictionary of Rocky Mountain Naturalists. Dr. W. Junk, The Hague/Boston.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Hansen, B. F. & R. P. Wunderlin. 1988. Synopsis of *Dichanthelium* (Poaceae) in Florida. Ann. Missouri Bot. Gard. 75: 1637–1657.

Hatch, S. L., K. N. Gandhi & L. E. Brown. 1990. Checklist of the Vascular Plants of Texas. The Texas Agricultural Experiment Station, Texas A&M University System, College Station.

Hitchcock, A. S. & A. Chase. 1910. The North American species of *Panicum*. Contr. U.S. Natl. Herb. 15: i–xiv, 1–396.

——— & ———. 1951. Manual of the Grasses of the United States, 2nd ed. U.S. Government Printing Office, Washington, D.C.

Kral, R. 1983. A report on some rare, threatened, or endangered forest-related vascular plants of the South. U.S.D.A. Forest Serv. Techn. Publ. R8-TP 2. 1: 83–86.

Nesom, G. L. 1995. Review of the taxonomy of *Aster* sensu lato (Asteraceae), emphasizing the New World species. Phytologia 77: 141–297.

Pennell, F. W. 1936. Elias Durand and his association with the Academy of Natural Sciences of Philadelphia. Bartonia 17: 33–39.

Reveal, J. L. & C. S. Keener. 1981. *Virgulus* Raf. (1837), an earlier name for *Lasallea* Greene (1903) (Asteraceae). Taxon 30: 648–651.

Semple, J. C. & L. Brouillet. 1980. A synopsis of North American asters: The subgenera, sections and subsections of *Aster* and *Lasallea*. Amer. J. Bot. 67: 1010–1026.

Small, J. K. 1933. Manual of the Southeastern Flora. Published by the author, New York.

Webster, R. D. 1987. The Australian Paniceae (Poaceae). J. Cramer, Berlin.

Wunderlin, R. P. 1998. Guide to the Vascular Plants of Florida. Univ. Press of Florida, Gainesville.

Xiang, C. & J. C. Semple. 1996. Molecular systematic study of *Aster* sensu lato and related genera (Asteraceae: Astereae) based on chloroplast DNA restriction site analysis and mainly North American taxa. *In:* D. J. N. Hind & H. J. Beentje (editors), Compositae: Systematics. Proceedings of the International Compositae Conference, Kew, 1994. 1: 393–423.

Delphinium calthifolium (Ranunculaceae), a New Species from Sichuan, China

Yang Qiner and Luo Yan

Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Chinese Academy of Sciences, 20 Nanxincun, Xiangshan, Beijing 100093, People's Republic of China

ABSTRACT. *Delphinium calthifolium* Q. E. Yang & Y. Luo, a new species of Ranunculaceae from Beichuan County, Sichuan Province, is described and illustrated. The new species is distinguished by its undivided, orbicular-cordate or broadly ovate-cordate leaves and very narrowly subulate-cylindric spur of the upper sepal. It is perhaps related to *D. delavayi* Franchet by its blue staminodes, with bifid, ventrally sparsely yellowish barbate limb, and its transversely undulate seed surface architecture of minute scales.

Key words: China, *Delphinium*, Ranunculaceae.

In the course of examining specimens of Ranunculaceae in the herbarium of the Chengdu Institute of Biology (CDBI), Chinese Academy of Sciences, the following new species of the genus *Delphinium* L. was discovered.

Delphinium calthifolium Q. E. Yang & Y. Luo, sp. nov. TYPE: China. Sichuan: Beichuan County, Badi District, Xikou, forest, 2300 m, Sep. 1984 (fl, fr), *C. L. Tang et al. 647* (holotype, CDBI; isotype, CDBI). Figure 1.

Herba perennis; caule cum inflorescentia 25–40 cm alto, densiuscule patenterque albido-hirtello, simplice, gracili. Folium basale 1; petiolo ca. 13 cm longo basi paulo dilatato; lamina indivisa, orbiculari-cordata vel late ovato-cordata, ca. 7 cm longa, ca. 6 cm lata, utrinque glabra, margine apiculato-crenata, apice acuminata. Folium caulinum 1; petiolo 1–5 cm longo; lamina ei folii basalis simili, raro minore et triloba, utrinque glabra vel supra sparse albido-hirtella. Inflorescentia racemosa, laxa, 3- ad 6-flora, 5–12 cm longa; rhachide adpresse hirtella; bracteis lanceolatis vel subulatis, integris, dense adpresse hirtellis, 0.5–1.0 cm longis, infimis interdum trilobis et majoribus; pedicellis divaricatis, 2–5 cm longis, adpresse hirtellis, prope medium 2-bracteolatis, bracteolis lanceolatis, 0.2–0.5 cm longis, dense hirtellis. Flores subhorizontales, ca. 3 cm longi; sepalo superiore late ovato, calcari tenuissme subulato-cylindrico, ca. 2.5 cm longo basi ca. 3 mm crasso paulo recurvato, extus pubescente intus glabro, lateralibus late ellipticis, ca. 12 mm longis, ca. 7 mm latis, inferioribus ellipticis, ca. 13 mm longis, ca. 5 mm latis; petalis caeruleis, glabris, apice acutis; staminodiis caeruleis, limbo ovato bifido ca. 7 mm longo, adaxialiter sparse flavido-barbato, margine sparse ciliato, ungue ca. 5 mm longo, glabro; staminibus numerosis, glabris, filamentis integris; ovariis 2 vel 3, glabris. Folliculi seminibus ellipsoideis, transversaliter undulato-lamellato-squamulosis.

Herbs perennial. Stem simple, slender, together with inflorescence 25–40 cm tall, densely spreading white hirtellous. Basal leaf 1; petiole ca. 13 cm, base slightly dilated; leaf blade undivided, orbicular-cordate or broadly ovate-cordate, ca. 7 × 6 cm, glabrous, margin apiculate crenate, apex acuminate. Cauline leaf 1; petiole 1–5 cm; leaf blade similar to basal one in shape, rarely smaller and trilobate, glabrous on both surfaces or sparsely whitish hirtellous adaxially. Inflorescence racemose, lax, 5–12 cm, 3- to 6-flowered; rachis appressed hirtellous; bracts lanceolate or subulate, undivided, 0.5–1.0 cm, densely appressed hirtellous, lowermost bract sometimes trilobate and larger. Flowers subhorizontal, ca. 3 cm; pedicel divaricate, 2–5 cm, appressed hirtellous, 2-bracteolate near middle; bracteoles lanceolate, 0.2–0.5 cm, densely hirtellous. Sepals blue; upper sepal broadly ovate; spur very narrowly subulate-cylindric, slightly downcurved, ca. 2.5 cm × ca. 3 mm thick at base, pubescent outside, glabrous inside; lateral sepals broadly elliptic, ca. 12 × 7 mm; lower sepals elliptic, ca. 13 × 5 mm. Petals blue, glabrous, apex acute. Staminodes blue; limb ovate, bifid, ca. 7 mm, ventrally sparsely yellowish barbate, margin sparsely ciliate; claw ca. 5 mm, glabrous. Stamens numerous, glabrous; filaments entire. Ovaries 2 or 3, glabrous. Seeds ellipsoid, transversely undulate lamellar squamulose.

Habitat and distribution. *Delphinium calthifolium* is currently known only from the type gathering, made in forest at 2300 m in Beichuan County in northern Sichuan Province. The type locality is not easily accessible and was probably never carefully botanized before the new species was collected in 1984.

Delphinium calthifolium is a remarkable species in the genus because of its undivided and orbicular-cordate or broadly ovate-cordate leaf blades as well as the very narrowly subulate-cylindric spur of the upper sepal. Staminodes are blue with a bifid,

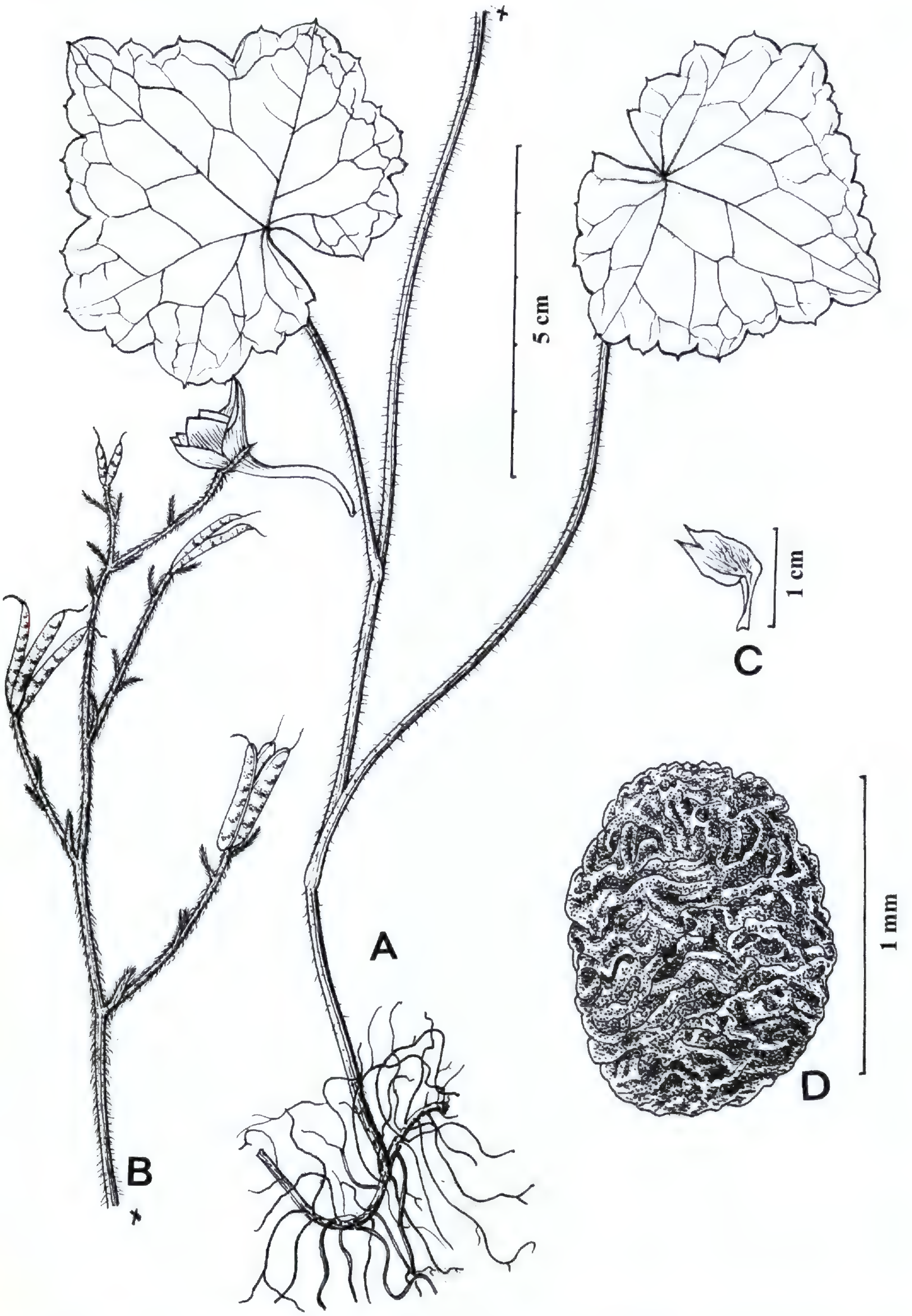


Figure 1. *Delphinium calthifolium* Q. E. Yang & Y. Luo. —A, B. Habit. —C. Staminode. —D. Seed. Drawn from the type gathering, *C. L. Tang et al. 647* (CDBI).

sparsely yellowish barbate limb; seed surfaces are remarkable for their transversely undulate surface architecture of minute scales. From these features of staminodes and seeds, this species may be most closely related to *D. delavayi* Franchet in *D.* subg. *Delphinastrum* (DC.) Petermann sect. *Elatopsis* Huth ser. *Pogonantha* W. T. Wang. The specific epithet refers to the similarity of the undivided, cordate leaves to those of *Caltha* L., another genus of Ranunculaceae.

Acknowledgments. We are most grateful to Gao Xinfen, curator of the Herbarium of Chengdu Institute of Biology, Chinese Academy of Sciences, for her kind help and hospitality during our sojourn in Chengdu. Our thanks also go to Wang Wentsai in the Laboratory of Systematic and Evolutionary Botany, Institute of Botany (Beijing), Chinese Academy of Sciences, for his invaluable direction during the course of research, and to Sun Yingbao for his illustration. This work was supported by the National Natural Science Foundation of China (Grant No. 30070057).

Volume 11, Number 3, pp. 289–372 of NOVON was published on 21 September 2001.

Volume 11
Number 4
2001

NOVON

Bertiera rugosa (Rubiaceae), a New Species from Ecuador

Lennart Andersson and Claes Persson
Botanical Institute, Göteborg University, P.O. Box 461, SE-405 30 Göteborg, Sweden

ABSTRACT. *Bertiera rugosa* is described and illustrated. It is known only from a single locality at ca. 2000 m altitude in southern Ecuador. It is distinguished by its conspicuously rugose leaves, short stipule sheaths, and pyramidal inflorescences. An updated key to Ecuadorian *Bertiera* is given.

Key words: *Bertiera*, Ecuador, Ixoroideae, Neotropics, Rubiaceae.

Andersson and Ståhl (1999) recognized four species of *Bertiera* in Ecuador, none of which is known to occur above 1000 m altitude. Recent fieldwork in the Podocarpus National Park of southern Ecuador revealed a fifth species in an area of montane forest at 2000 m altitude. This new species is formally described below. Its most conspicuous feature is its firm-textured, distinctly rugose leaves, which make it different from all other Ecuadorian species.

Bertiera rugosa L. Andersson & C. Persson, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Podocarpus National Park, road Loja–Zamora, ca. km 15, Quebrada de San Francisco, on trail from visitors hut past Quebrada del Diablo, 03°59′S, 79°08′W, ca. 2000 m, 22 Mar. 2000, *C. Persson 496* (holotype, QCNE; isotypes, GB, LOJA, MO, S). Figure 1.

Differt a speciebus omnibus neotropicis *Bertierae* foliis manifeste rugosis.

Shrub, ca. 1 m tall. Young branches rather densely pubescent from coarse, obliquely upward-directed hairs to ca. 1 mm long, hairs long-persistent. Stipules 0.7–1.1 cm long with sheath 0.2–0.5 cm and lobe 0.5–0.8 cm, rather densely and coarsely pubescent medially, glabrous or subglabrous marginally. Leaf blades ovate, 6.2–9.9 × 1.7–3.7 cm, length/width ratio 2.4–3.6, drying ± greenish, chartaceous when dry, the base rounded, the apex acute to vaguely acuminate, secondary veins 7 to 10 pairs, midrib and secondary and tertiary veins deeply impressed above, strongly prominent beneath (and leaf surface hence distinctly rugose), the adaxial surface ± nitid, the midrib rather densely hirsute, but surface otherwise glabrous, the abaxial surface pubescent on midrib, veins, and veinlets, glabrous in between, domatia absent; petioles 0.1–0.3 cm, rather densely pubescent both ab- and adaxially. Inflorescence pyramidal, 2.5–5.5 × 3.5–5 cm, the first 1–3 ramifications dichasial, subsequent ones monochasial, monochasia with 2 to 5 flowers, axes rather densely and coarsely pubescent, bracts of monochasia 1.7–2.9 mm, pedicels obsolete, interfloral axis segments 2.7–3.3 mm, branches not proliferating. Calyx ca. 2 mm long, glabrous both outside and within, without colleters or with few and small ones, the tube ca. 0.5–0.6 mm long, the lobes narrowly triangular to ± lingular, 1.5–1.7 mm long, the sinuses wide and U-shaped; corolla yellowish white, the tube ca. 2.7 mm long, glabrous outside, densely villous inside in upper half, the lobes ca. 2.7 mm long, glabrous abaxially, ± villous adaxially in lower quarter; anthers ca. 1.8 mm long, including a distinct, subulate connective process ca. 0.5 mm; ovary glabrous or very sparsely and irregularly puberulous at base, obconical, ca. 1.5 × 1.7 mm, bilocular with 8 to 12 ovules per locule; style ca. 1.1 mm long, glabrous, stigmatic lobes ca. 2.2 mm long, each with 4 longitudinal ridges on abaxial side. Fruits globose, 5–6 mm diam., pericarp without fiber bundles (and thus not ridged when dry), each locule with

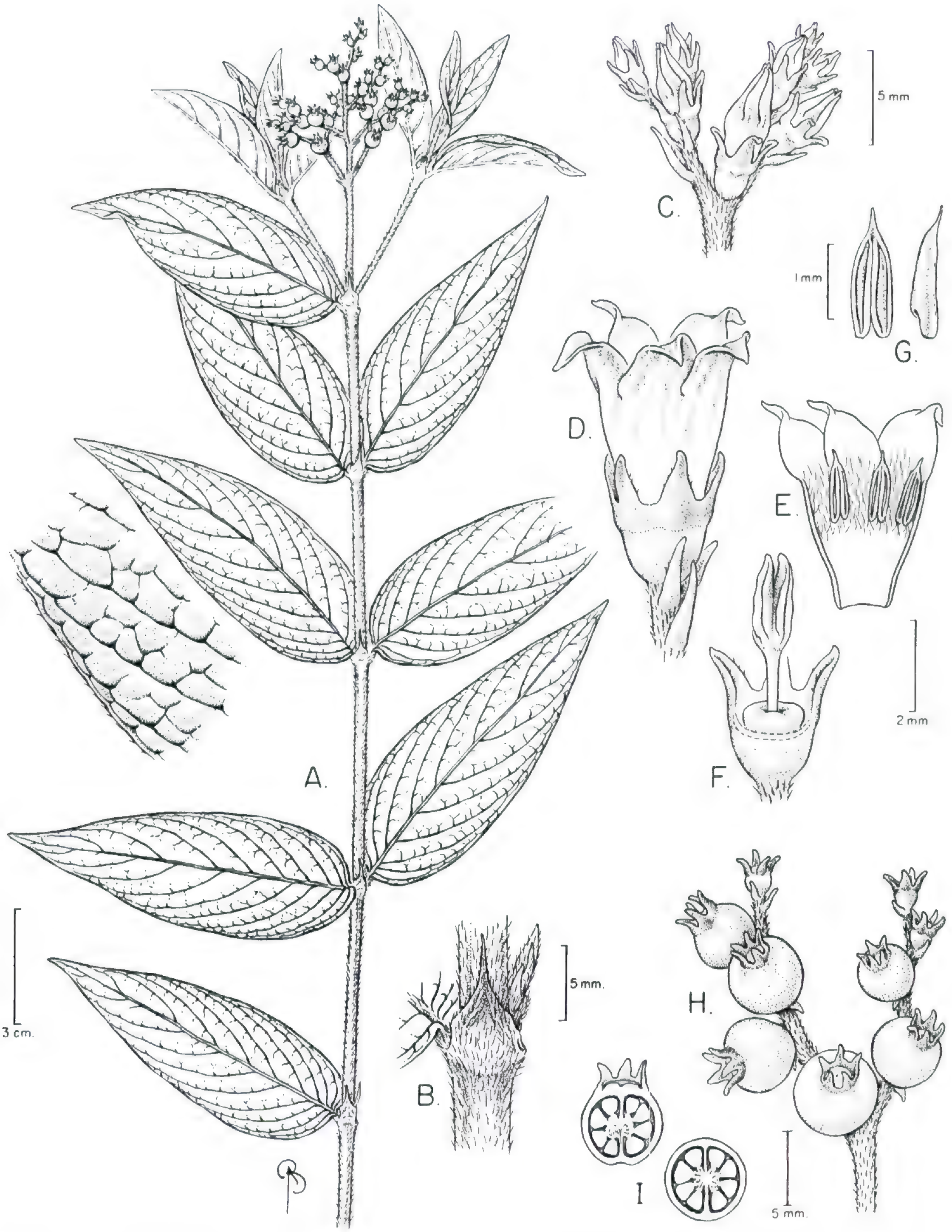


Figure 1. *Bertiera rugosa.*—A. Habit of fruiting branch; detail of leaf surface shown at left. —B. Vegetative node showing stipules. —C. Inflorescence branch with flower buds. —D. Open flower. —E. Corolla cut open, longitudinal view. —F. Ovary with calyx, disk, style, and stigma. —G. Anthers in adaxial and side views. —H. Infructescence branch. —I. Fruit cut longitudinally (left) and transversally. (All drawn from the type collection.)

ca. 8 well developed (and often 1 or 2 aborting) seeds. Seeds polyhedral, ca. 1.7 mm along longest axis.

The type specimens were collected in an area where the vegetation was sparse due to a relatively recent landslide. The type locality is remarkable for its high altitude; no other Ecuadorian collection of *Bertiera* exists from above 1000 m. It also seems odd that no other collection of this species was seen among the material studied during the preparation of the treatment for the *Flora of Ecuador* (Andersson & Ståhl, 1999). The Podocarpus National Park has been intensively inventoried in recent years. It may be that collections of this species are hiding among the many collections of Rubiaceae that have not been identified to genus; the genus *Bertiera* is rather undistinguished to the untrained eye.

Bertiera rugosa is conspicuous because of its distinctly rugose leaf blades, which have even the tertiary venation deeply immersed on the adaxial side. Although there is no published description of a neotropical *Bertiera* with rugose leaves, *B. viburnoides* (Standley) J. H. Kirkbride may often have this characteristic (C. M. Taylor, pers. comm.). *Bertiera viburnoides* is also a species of high altitudes, known from the Cordillera Occidental of northwestern Colombia. It seems to be a larger plant and differs further from *B. rugosa* in having distinctly acuminate leaf blades with fewer (5–6 pairs) lateral veins and a densely corymbose inflorescence.

Among Ecuadorian species, the closest match of *B. rugosa* is *B. pubiflora* (Steyermark) L. Andersson & B. Ståhl. *Bertiera pubiflora* shares with *B. rugosa* the feature of having markedly ovate leaf blades, which dry greenish (rather than blackish), and also have a more marked venation than *B. guianensis* Aublet and *B. procumbens* K. Schumann & K. Krause. However, no specimen of *B. pubiflora* approaches *B. rugosa* even remotely in leaf sculpture. Furthermore, *B. pubiflora* is consistently distinguishable by its long inflorescence bracts.

The five species of *Bertiera* now known to occur in Ecuador may be distinguished using the following key, which is adapted from Andersson and Ståhl (1999).

1a. Lateral branches of inflorescence lax with a distance between flowers of 2–9 mm; connective process 0.3–0.8 mm long, forming 1/4–1/2 of total anther length; ovules (2)4 to 20 per locule.
  2a. Leaf blades rugose, with secondary and tertiary veins deeply immersed above and strongly prominent beneath; stipule sheath 2–5 mm long . . . . . *B. rugosa*
2b. Leaf blades not rugose, secondary veins level or slightly immersed above, prominulous beneath, tertiary veins ± level on both sides and often hardly visible; stipule sheath 4–13 mm long.
  3a. Pedicels short but distinct (0.1–0.5 mm); ovules (2)4 per locule; fruits ± smooth . . . . . *B. procumbens*
  3b. Pedicels obsolete; ovules 5 to 19 per locule; fruits (at least when dry) with ca. 10 ± strongly raised longitudinal ribs radiating from calyx.
    4a. Leaf blades drying blackish; bracts of inflorescence branches 1–4 mm long; calyx lobes 0.4–0.5 mm long . . . . . *B. guianensis*
    4b. Leaf blades drying grayish to greenish; bracts of inflorescence branches 5–16 mm long; calyx lobes 0.7–1.5 mm long *B. pubiflora*
1b. Lateral branches of inflorescence strongly condensed with axes between flowers hardly perceptible; connective process ca. 0.2 mm long, forming ca. 1/10 of total anther length; ovules 2 per locule . . *B. bracteosa* (J. Donnell Smith) B. Ståhl & L. Andersson

Acknowledgments. Claes Persson's fieldwork was supported by the Royal Swedish Academy of Sciences (A. F. Regnells Botaniska Gåvomedel). The illustration was made by Bobbi Angell. We gratefully acknowledge constructive and helpful comments from Piero Delprete (NY) and Charlotte M. Taylor (MO).

Literature Cited

Andersson, L. & B. Ståhl. 1999. *Bertiera* Aubl. Pp. 120–129 *in* G. Harling & L. Andersson (editors), Flora of Ecuador 62. Nordic Council for Publications in Botany, Copenhagen.

New Combinations in the Genus *Neomarica* (Iridaceae) and Its Segregation from *Trimezia* on the Basis of Morphological Features

Nadia Said Chukr

City Government of Sao Paulo, Parks and Recreation Department., Av. Paulista, 2073, CEP 01311-940, São Paulo S.P., Brazil

Ana Maria Giulietti

State University of Feira de Santana, Km 03, BR 111, Campus Universitário, Feira de Santana, Bahia, CEP 441.100, Brazil

Abstract. This paper recognizes the genus *Neomarica* Sprague (Iridaceae), contradicting the treatment by Ravenna placing the genus in synonymy under *Trimezia* Salisbury ex Herbert. *Neomarica* is distinguished by its caulinar system as a rhizome or corm, equitant and conduplicate leaves, and conduplicate scapes with a leaflike bract in the apex, which apparently is a sterile prolongation of it; *Trimezia* is characterized by the exclusive presence of corms, spiraled disposition of cataphylls and leaves, and terete scapes. As a result of this work, nine new combinations and five new synonyms are proposed.

Key words: Iridaceae, *Neomarica, Trimezia.*

The genera *Neomarica* Sprague and *Trimezia* Salisbury ex Herbert had always been considered as distinct, if closely related, genera until recently (Klatt, 1861–1862, 1871; Baker, 1877, 1892; Bentham & Hooker, 1883; Hutchinson, 1934; Goldblatt, 1982, 1990; Henrich & Goldblatt, 1987; Rudall, 1994). The name *Neomarica* was first proposed by Sprague (1928), following Baker (1877, 1892), based on Herbert's (1840) review for *Marica*; Herbert (and Baker) differentiated *Marica* from *Lansbergia* (= *Trimezia*) on the basis of the presence of conduplicate and equitant leaves and scapes. *Trimezia* was characterized by the presence of spirally arranged cataphylls, terete or linear leaves, terete scapes, and deeply bifid styles (Herbert, 1844; Bentham & Hooker, 1883).

The name *Marica* was initially proposed by Schreber (1789) in order to replace *Cipura* Aublet (Aublet, 1775), only because Schreber did not like the name *Cipura*. He used the same holotype of *Cipura*, and therefore it is illegitimate. Even so, *Marica* was adopted during the period from 1803 to 1827 by Ker Gawler, in such a broad sense that today it would embody nine different genera and include *Marica paludosa* Schreber, the type species of *Cipura* Aublet and *Marica* Schreber. According to Sprague (1928), Herbert (1840) completely changed the original application of *Marica* by excluding *M. paludosa* and typifying the genus to *Marica northiana* (Schneevoogt) Ker Gawler. In Sprague's view, Herbert thus established a new genus requiring a new name.

According to Ravenna (1988), exceptions can be found in the diagnostic characters listed above, as for example in *Trimezia violacea* (Klatt) Ravenna, which he considered to have equitant cataphylls, and in *T. rupestris* Ravenna and *T. paradoxa* Ravenna, which he considered to have spirally arranged cataphylls. As a result, Ravenna (1988) placed *Neomarica* under *Trimezia* recognizing sections *Neomarica, Juncella, Platyella,* and *Calolirion.* Ravenna's treatment of *Neomarica* and *Trimezia* (1977) was not accepted by such other authors as Goldblatt (1982) and Henrich and Goldblatt (1987).

The use of the name corm for the subterranean caulinar system was based on Chueiri-Chiaretto and Menezes (1980) and Chueiri-Chiaretto (1987), who have studied the anatomy of the underground structure of *Trimezia,* which is here also applied to *Neomarica* species.

Material and Methods

This work followed classic methodology for taxonomic studies, associating herbarium research with field trips. Three *Trimezia* species were examined from among 17 recognized for the genus and 9 species from *Neomarica,* which are listed below: *Trimezia juncifolia* (Klatt) Bentham & Hooker, *Trimezia fistulosa* Foster var. *fistulosa, Trimezia violacea* (Klatt) Ravenna, *Neomarica rupestris* (Ravenna) Chukr, *Neomarica paradoxa* (Ravenna)

Chukr, *Neomarica sabini* (Lindley) Chukr, *Neomarica caulosa* (Ravenna) Chukr, *Neomarica sylvestris* (Vellozo) Chukr, *Neomarica rotundata* (Ravenna) Chukr, *Neomarica portosecurensis* (Ravenna) Chukr, *Neomarica fluminensis* (Ravenna) Chukr, and *Neomarica nitida* (Ravenna) Chukr.

Patterns of shapes and sizes of caulinar systems, leaves, scapes, inflorescences, bracts, tepals, stamens, and styles of *Trimezia* and *Neomarica* species were observed. Observations of the color of the flowers and stripes on outer and inner tepals, and the type of style apex and stamens were recorded from field populations, when possible. The field studies took place in Serra do Cipó, Minas Gerais (Chukr, 1992), Espinhaço Range in the States of Minas Gerais and Bahia, and in Atlantic Forest, mostly in the southeast of Brazil. The herbaria consulted for this work were: BHMH, BR, CEPEC, F, HB, K, M, MBM, NY, R, RB, SP, SPF.

Results and Discussion

In *Trimezia violacea*, the underground systems were found to consist of a corm with spirally arranged cataphylls (Fig. 1c). This contradicts the findings of Ravenna (1988), who regarded this species as possessing a rhizome. However, in this species the cataphylls are less fibrous, perhaps due to the wet conditions where the plant usually occurs. In species growing in more arid areas, the cataphylls are invariably more fibrous.

An examination of the underground structures of *Trimezia rupestris* and *T. paradoxa*, both species here considered as belonging to *Neomarica*, clearly showed the cataphylls to be equitant and not spiraled, as proposed by Ravenna (1988). However, unusually for *Neomarica*, these two species were found to possess corms rather than rhizomes.

Comparing "*Neomarica*" *rupestris* (Fig. 1a) with a typical *Trimezia* species, such as *T. fistulosa* Foster. var. *fistulosa* (Fig. 1d), the different arrangement of the cataphylls in the corm can be seen. In the former species the typical distichous *Neomarica* arrangement of the leaves may be observed, not the spiral arrangement found in *T. fistulosa* var. *fistulosa* and other typical *Trimezia* species, such as *T. juncifolia* (Klatt) Bentham & Hooker (Fig. 1b).

From the studies we undertook, it is now possible to itemize the main vegetative differences between *Trimezia* and *Neomarica* (Table 1). During these studies, other diagnostic characters were discovered: in *Neomarica*, the scapes are flattened with a pseudo-midrib, while in *Trimezia* these are always terete. This is of particular value as a field character, and is also easily seen in herbarium material.

While vegetative characters provide good diagnostic characters to separate the two genera, the floral morphology was found to be of little systematic value. However, the inflorescence type gives some taxonomic clues. In *Neomarica* the inflorescence is lateral (Table 1), while in *Trimezia* this character is not common. Also the presence of a terminal bract on the scape occurs in all *Neomarica* species, while in *Trimezia* it occurs in only about 30% of species (Table 1). This pattern is well known in Iridaceae, where floral characters were found to be of little value to separate *Homeria* and *Moraea* (Goldblatt, 1986), or *Gynandriris*, *Mastigostyla*, and *Moraea* subg. *Viesseuxia* (Ravenna, 1981).

As a result of the above findings, it seems clear that *Neomarica* is a genus distinct from *Trimezia*.

Neomarica Sprague, Bull. Misc. Inform. Kew 1928(7): 280. 1928. TYPE: *Neomarica northiana* (Schneevoogt) Sprague (basionym: *Moraea northiana* Schneevoogt, Ic. Pl. Rar., tab. 41, 42. 1793. 1793).

Galathea Liebmann, Ind. Sem. Hort. Haun. 26. 1855. TYPE: *Galathea speciosa* Liebmann.

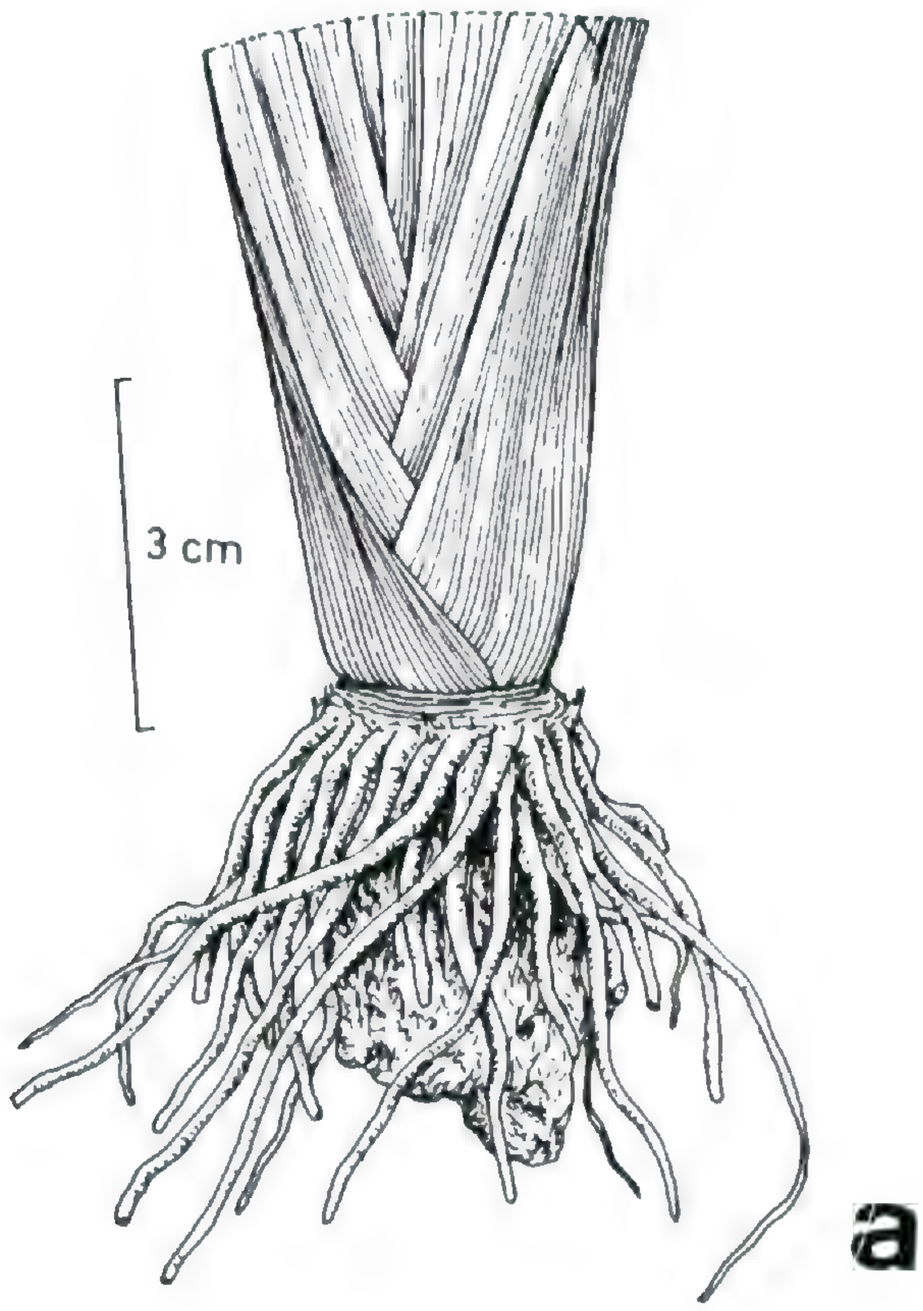
Trimezia Salisbury ex Herbert sect. *Calolirion* Ravenna, Onira 1(1): 15. 1988. Syn. nov. TYPE: *Trimezia caerulea* (Ker Gawler) Ravenna (basionym: *Marica caerulea* Ker Gawler, Edward's Bot. Reg., tab. 713. 1823).

Trimezia Salisbury ex Herbert sect. *Platyella* Ravenna, Onira 1(1): 15. 1988. Syn. nov. TYPE: *Trimezia paradoxa* Ravenna.

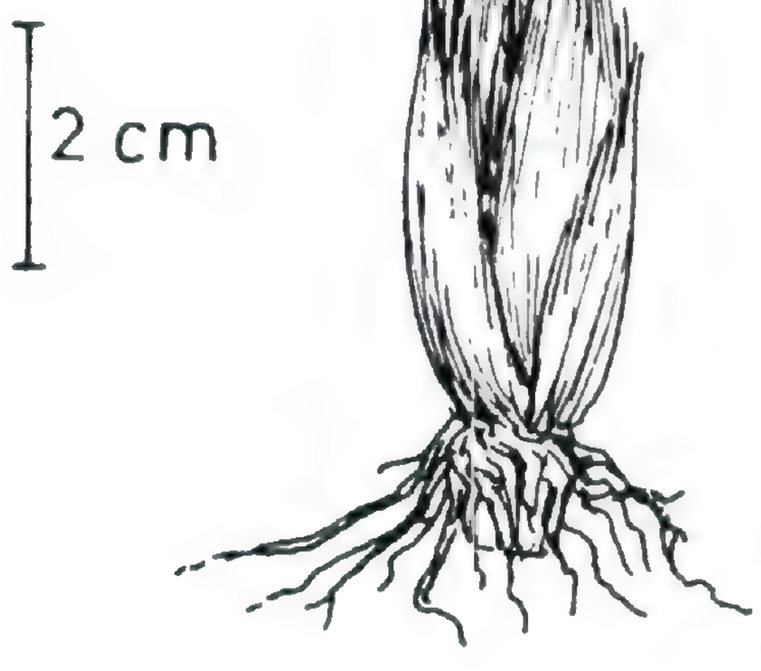
Underground system a rhizome, or rarely, corm with cataphylls equitant; leaves ensiform, equitant and conduplicate; scapes foliaceous, flattened and conduplicate, apex with two bracts, lower larger and appearing as a continuation of the scape; flowers white, blue or yellow, fugaceous, outer tepals very different from the inner in shape and size, inferior region of the outer tepals with wine-colored stripes and capitate hairs, medium and superior regions of the inner tepals with wine-colored stripes and capitate hairs, stamens opposite the styles, styles entire, trifid or bifid at the apex; fruit a loculicidal capsule.

According to Henrich and Goldblatt (1987), *Neomarica* has a neotropical distribution with ca. 15 species widespread on the east coast of Brazil, in the states of Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Minas Gerais, Paraná, and Santa Catarina, in restingas areas or in forest borders.

1. **Neomarica caulosa** (Ravenna) Chukr, comb. nov. Basionym: *Trimezia caulosa* Ravenna,

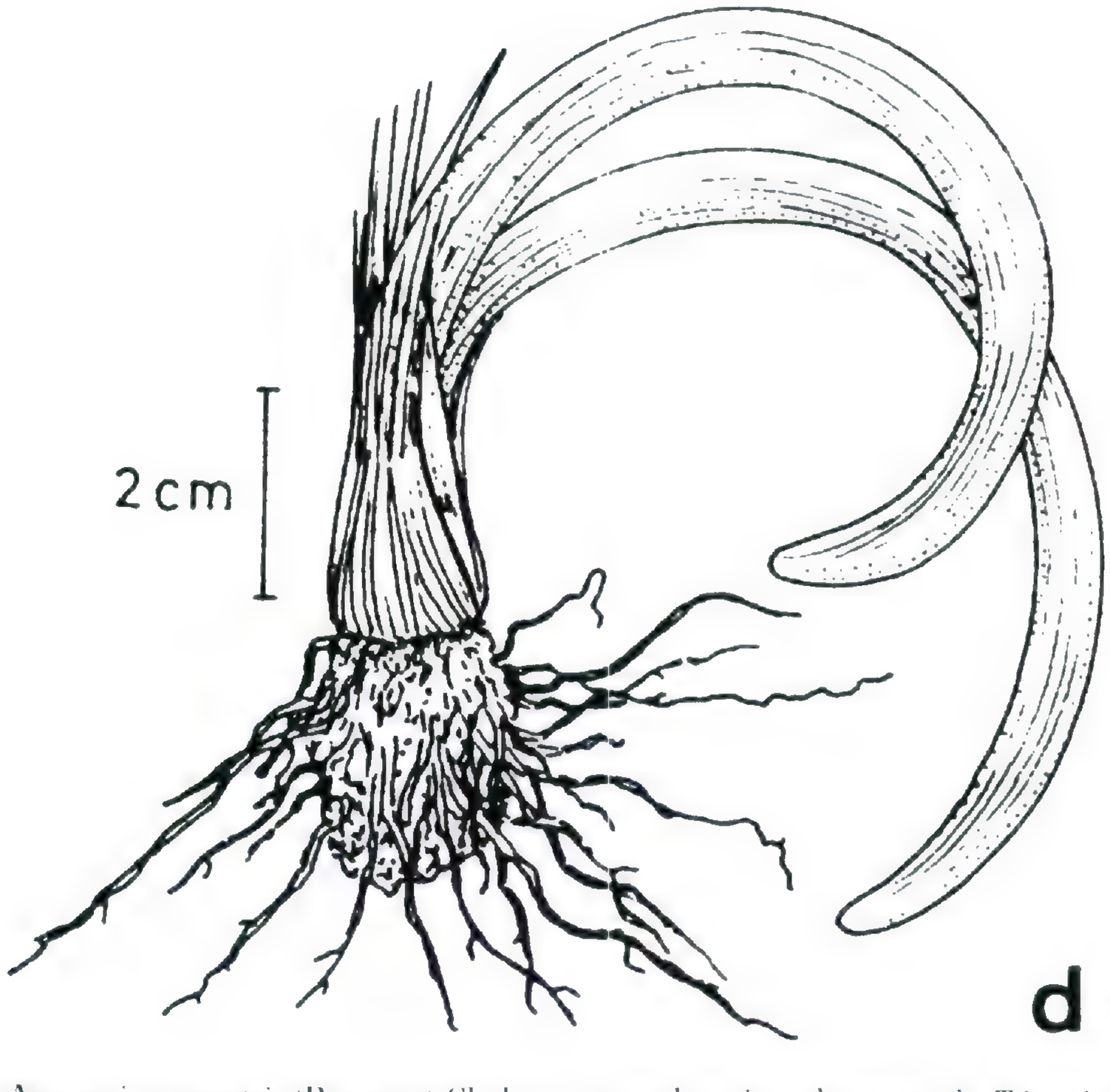


a



b

c



d

Figure 1. Subterranean systems. —a. *Neomarica rupestris* (Ravenna) Chukr: corm and equitant leaves. —b. *Trimezia juncifolia* (Klatt) Bentham & Hooker: corm and spiraled leaves. —c. *Trimezia violacea* (Klatt) Ravenna: corm and spiraled leaves. —d. *Trimezia fistulosa* Foster var. *fistulosa*: corm and spiraled leaves.

Wrightia 7(2): 94. 1982. TYPE: Brazil. Bahia: Porto Seguro, 3 Nov. 1978, *A. Espunino 368* (holotype, Herb. Ravennae not seen).

The paratype's underground system, which is a short rhizome, left doubts as to the generic position of this material, but the equitant disposition of the leaves and the flattened scape definitively placed it in *Neomarica*.

Paratype. BRAZIL. **Bahia:** Santa Cruz da Cabralia, 15 Sep. 1971, *T. S. Santos 1924* (CEPEC).

Table 1. Distinguishing characters between *Neomarica* and *Trimezia*. Legend: % = percentage of occurrence in the species of the genus.

Characters	*Trimezia*	*Neomarica*
Type of underground system	Corm	Rhizome or corm
Presence of corm (%)	100	10
Cataphylls arrangement	Spiral	Equitant
Leaf form	Plane or terete	Ensiform
Conduplicate leaves (%)	0	100
Scape form	Terete	Flattened
Foliaceous scape (%)	0	100
Terminal bract on the scape (%)	30	100
Lateral inflorescence (%)	30	100

2. Neomarica fluminensis (Ravenna) Chukr, comb. nov. Basionym: *Trimezia fluminensis* Ravenna, Onira 1(1): 10. 1988. TYPE: Brazil. Rio de Janeiro: Estrada da Vista Chinesa, 15 Sep. 1971, *G. Martinelli et al. 58* (holotype, RB).

The analysis of the holotype of *Trimezia fluminensis* revealed a rhizome system, conduplicate and flattened leaves and scapes, lateral inflorescences, and equitant cataphylls. *Neomarica fluminensis* is similar to *Neomarica sabini* but differs in the smaller size of individuals and in the anatomical features from the endodermal line.

3. Neomarica nitida (Ravenna) Chukr, comb. nov. Basionym: *Trimezia nitida* Ravenna, Onira 1(1): 8–9. 1988. TYPE: Brazil. São Paulo: São Paulo, Feb. 1966, *Ravenna 492* (holotype, Herb. Ravennae not seen).

This species was examined from several paratypes housed in SP. Species characteristics corroborate its inclusion in *Neomarica* because of the presence of a rhizome, equitant and conduplicate leaves, conduplicate scapes, and a lateral inflorescence.

Paratypes. BRAZIL. **São Paulo:** Paranapiacaba, Jan. 1913, *Luederwaldt 1181* (SP); São Paulo, *O. Handro s.n.* (SP 69.764); São Paulo, Ilha Queimada Grande, Apr. 1923, *Dr. Apicurio 15* (SP).

4. Neomarica paradoxa (Ravenna) Chukr, comb. nov. Basionym: *Trimezia paradoxa* Ravenna, Onira 1(1): 4. 1988. TYPE: Brazil. Maranhão: Pastos Bons, Mar. 1966, *Ravenna 475* (holotype, Herb. Ravennae not seen; isotypes, K, RB not seen).

The isotype of *Trimezia paradoxa* Ravenna was analyzed by photography (*Ravenna 475*, K). It is evidently a species of *Neomarica* due to its flattened scape and lateral and axillary inflorescences. The styles are entire in the apex, a feature that is diagnostic for this species.

5. Neomarica portosecurensis (Ravenna) Chukr, comb. nov. Basionym: *Trimezia portosecurensis* Ravenna, Onira 1(1): 7–8. 1988. TYPE: Brazil. Bahia: Santa Cruz da Cabralia, 17 Oct. 1971, *T. S. Santos 1954* (holotype, Herb. Ravennae not seen; isotype, CEPEC).

The isotype and paratypes of this species were examined. It was possible to verify the major characteristics of *Neomarica*, such as the conduplicate scape and the rhizome as the underground system. The other major characteristic of the species is the trifid apex of the style, where the lateral branches are smaller than the central one.

Paratypes. BRAZIL. **Bahia:** Santa Cruz da Cabralia, 18 Oct. 1973, *A. Eupurino 384* (CEPEC, RB), 19 Oct. 1978, *S. A. Mori et al. 10849* (CEPEC, RB).

6. Neomarica rotundata (Ravenna) Chukr, comb. nov. Basionym: *Trimezia rotundata* Ravenna, Onira 1(1): 2–3. 1988. TYPE: Brazil. Paraná: Garuva, Dec. 1969, *Ravenna 760* (holotype, Herb. Ravennae not seen; isotypes, BR not seen, K, MBM not seen, RB not seen).

This species belongs to *Neomarica*, because it possesses a rhizome, conduplicate scape, and ensiform leaves.

7. Neomarica sabini (Lindley) Chukr, comb. nov. Basionym: *Marica sabini* Lindley, Trans. Hort. Soc. London 6: 75, tab. 1. 1826, non *Marica sabini* Loddiges, 1826. *Trimezia sabini* (Lindley) Ravenna, Extinction is Forever: 257. 1977. TYPE: Trans. Hort. Soc. London 6: 75, tab. 1. 1826.

The name *Marica sabini* Lindley was applied to

materials with *Neomarica* characteristics such as the presence of conduplicate leaves and scapes and a rhizome as a subterranean caulinar system. Ravenna (1977) proposed the species transfer to *Trimezia* and used the name *T. sabini* (Lindley) Ravenna to identify the materials *S. G. Vinha & T. S. Santos 166* (CEPEC, RB). The taxon typically has an inflorescence with three or more rhipidiums, one being sessile to the leaf-like bract and the other pedunculate.

8. Neomarica sylvestris (Vellozo) Chukr, comb. nov. Basionym: *Iris sylvestris* Vellozo, Fl. Flum.: 34. 1829; Icones, tab. 82. 1831. *Trimezia sylvestris* (Vellozo) Ravenna, Extinction is Forever: 257. 1977. TYPE: Fl. Flum.: 34. 1829; Icones, tab. 82. 1831.

Neomarica heloisamariae Occhioni, Rodriguesia 10(20): 80. 1946. Syn. nov. TYPE: Brazil. Rio de Janeiro, Sep. 1945, *Occhioni s.n.* (holotype, RB 56.701 RB).

Iris sylvestris was described by Vellozo (1829) based on material from Rio de Janeiro. The characteristics of the species, however, place it in *Neomarica*, especially its underground system in the form of a rhizome, its flattened scape, and the lateral and axillary inflorescence. Vellozo (1829) erred when he put the species in *Iris* because it does not have enlarged or petaloid styles. *Neomarica sylvestris* is well delimited in the genus because of its short height and sessile lateral inflorescence. The species is widespread in the state of Rio de Janeiro, in restingas, and is also found in the state of São Paulo.

Occhioni (1946) proposed the taxon *Neomarica heloisamariae* based on material from Rio de Janeiro. Our analysis of the *N. heloisamariae* material did not show significant differences from *N. sylvestris*, so *N. heloisamariae* is here considered a synonym.

9. Neomarica capitellata (Ravenna) Chukr, comb. nov. Basionym: *Trimezia capitellata* Ravenna, Onira 1(1): 2. 1988. TYPE: Brazil. Minas Gerais: Itacambira, Serra dos Alagoas, Jan. 1963, *Ravenna 197* (holotype, Herb. Ravennae not seen).

The holotype of *N. capitellata*, as indicated to be in the Ravennae Herbarium, could not be examined, because the material from the state of Minas Gerais was not sent to be analyzed. However, the original description leaves no doubt of the inclusion of the material in *Neomarica*, especially because of the inflorescence arrangement in an axillary position relative to the leaflike bract, and the rhizome system.

Acknowledgments. The authors are grateful to Raymond Harley for his help in the English translation, to CAPES for the research grant, and to Emiko Naruto for preparing the illustration. This work was developed in the Systematic Botany Laboratory of the Institute of Biosciences, University of São Paulo.

Literature Cited

Aublet, F. 1775. *Cipura.* Histoire des Plantes de la Guiane Françoise: 38–39. Didot, Paris.

Baker, J. G. 1877. Systema Iridacearum. J. Linn. Soc. Bot. 16: 61–180.

———. 1892. Handbook of Irideae. George Bell & Sons, London.

Bentham, G. & J. D. Hooker. 1883. Genera plantarum, v. 3, pt. 2, pp. 686–710. L. Reeve, London.

Chueiri-Chiaretto, I. A. 1987. Estrutura secundária do cormo de *Trimezia* Salisbury ex Herbert (Iridaceae). Ci. & Cult. 39(8): 651–654.

——— & N. L. Menezes. 1980. Reflections of the morphological evolutionary characteristics of the corm of *Trimezia* (Iridaceae). Bol. Bot. Univ. Sâo Paulo 8: 1–6.

Chukr, N. S. 1992. Flora da Serra do Cipó, Minas Gerais: Iridaceae. Bol. Bot. Univ. Sâo Paulo 13: 111–131.

Goldblatt, P. 1982. Chromosome cytology in relation to suprageneric systematics of neotropical Iridaceae. Syst. Bot. 7: 186–198.

———. 1986 Convergent evolution of the *Homeria* flower type in six new species of *Moraea* (Iridaceae, Irideae) in Southern Africa. Ann. Missouri Bot. Gard. 73: 102–116.

———. 1990. Phylogeny and classification of Iridaceae. Ann. Missouri Bot. Gard. 77: 607–627.

Henrich, J. E. & P. Goldblatt. 1987. The Mesoamerican *Neomarica* (Iridaceae), *N. variegata* Henrich & Goldblatt, comb. nov. Ann. Missouri Bot. Gard. 74: 911.

Herbert, W. 1840. *Marica humilis.* Bot. Mag. 67, tab. 3809.

———. 1844. *Trimezia meridensis.* Edwards's Bot. Reg. 30 Misc.: 88.

Hutchinson, J. 1934. The Families of Flowering Plants. Monocotyledones. Clarendon Press, Oxford.

Klatt, F. W. 1861–1862. Specimen et familia Iridearum. Linnaea 31: 533–570.

———. 1871. "Iridae" *in* C. F. P. Martius (editor), Flora brasil. 3(1): 510–548.

Occhioni, P. 1946. Uma Nova Especie de *Neomarica* para o Distrito Federal. Rodriguesia 9(20): 79–81.

Ravenna, P. F. 1977. Neotropical species threatened and endangered by human activity in Iridaceae, Amaryllidaceae and allied bulbous families. Pp. 257–263 *in* G. T. Prance & T. S. Elias (editors), Extinction is Forever. The New York Botanical Garden, New York.

———. 1981. The tribe Trimezieae of the Iridaceae. Wrightia 7(1): 12.

———. 1988. New species and miscellaneous notes in the genus *Trimezia* (Iridaceae)—II. Onira 1(1): 1–15.

Rudall, P. J. 1994. Anatomy and systematics of Iridaceae. Bot. J. Linn. Soc. 114: 1–21.

Schreber, J. C. D. v. 1789. *Marica paludosa.* Gen. Pl. 1: 37.

Sprague, T. A. 1928. *Marica* and *Neomarica.* Bull. Misc. Inform. 1928: 278–281.

Vellozo, J. M. C. 1829. Fl. Flum.: 34; Icones, tab. 82. 1831.

New Amazonian Taxa of *Philodendron* (Araceae)

Thomas B. Croat
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.

Amisha Shah
Washington University, St. Louis, Missouri, U.S.A.

ABSTRACT. Two taxa of *Philodendron*, *P. asplundii* Croat & M. L. Soares and *P. heleniae* subsp. *amazonense* Croat, are described as new. Both are known only from the Amazon basin, and both are widespread taxa that until now have remained unnamed. *Philodendron asplundii* is a member of *Philodendron* subg. *Philodendron* sect. *Philodendron* and is native to French Guiana, Venezuela, Brazil, Colombia, Ecuador, and Peru. While it is highly variable in terms of blade shape, it is characterized by having cataphylls that weather into a network of fine fibers with thin patches of epidermis and blades with prominently raised cross-veins extending between the minor veins. *Philodendron heleniae* subsp. *amazonense* is a member of *Philodendron* subg. *Philodendron* sect. *Calostigma* subsect. *Oligocarpidium* and is native to Colombia, Ecuador, Peru, and Bolivia. It is characterized by its scandent habit, the moderately elongate reddish brown-drying internodes, subterete petioles, narrowly ovate, subcordate yellow-brown drying blades, and clusters of up to 5 small whitish inflorescences.

Key words: Amazon, Araceae, hemiepiphyte, *Philodendron*.

Philodendron asplundii Croat & M. L. Soares, sp. nov. TYPE: Ecuador. Napo: vicinity of Baeza, on steep slopes above town of Baeza and road between Baeza and Lago Agrio (Nuevo Loja), virgin forest at edge of pastures, 2500 m, 19 Dec. 1979, *T. B. Croat 49444* (holotype, MO-2737423–24; isotypes, COL, F, INPA, K, M, NY, QCA, QCNE, US). Figures 1, 2, 3.

Planta hemiepiphytica; internodiis (2)4–8 cm longis, (0.6)3.0–5.0 cm diam.; cataphyllis 21–44 cm longis; acute 2-costatis vel D-formibus, persistentibus intactis in fibras tenues lacerantibus. Folium petiolo subtereti, 17–60(100) cm longo; lamina plerumque anguste ovato-triangulari vel late ovata, interdum truncata, 17–49(68) cm longa, 7.6–36.0 cm lata. Inflorescentiae usque ad 8 in quaque axilla; pedunculo 3.0–15.5 cm longo; spatha 8.0–14.5(17.0) cm longa, tubo 3.0–5.3 cm longo, 2.0–3.6 cm diam., viridi vel pallide externe, interne interdum pallide rubro, lamina alba vel flava; spadice usque ad 13 cm longo, parte pistillata ca. 1.9–2.2 cm longa, ca. 1.4 cm diam. Ovarium 4-ad 7-loculare; ovulis ca. 25 in quoque loculo. Baccae flavidae subaurantiacae vel viridi-albae.

Appressed-climbing hemiepiphyte to 1–3 m above ground, rarely terrestrial; stems to 1 m long; internodes short, (2)4–8 cm long, (0.6)3–5 cm diam.; cataphylls 21–44 cm long, faintly to sharply 2-ribbed to sharply D-shaped, green or green-tinged weakly with red or purple, drying brown with distinct striations, persisting intact to semi-intact and dilacerating into a net of fine fibers with mucilage (with thin patches of epidermis), epidermis brown to rusty-brown; petioles terete to obtusely flattened adaxially, 17–60(100) cm long (av. 35.7 cm), 0.54–1.69 times longer than blade (av. 1.08 times longer), 0.6–1.2 cm diam. midway, firm, semiglossy, gray-green to medium and dark green, sometimes dark green with darker green lines; geniculum 1.3–3 cm long, sometimes slightly darker, scurfy, slightly broader than petioles; sheath short or almost absent, up to 3 cm long; leaf blades lanceolate (probably pre-adult), narrowly ovate-triangular to broadly ovate and sometimes truncate, 17–49(68) cm long (av. 40 cm), 7.6–36 cm wide (av. 19 cm), and 1.2–3.9 times longer than wide (av. 2.4 times), acuminate at apex, subcoriaceous to coriaceous, weakly glossy to glossy, dark green and matte, slightly bicolorous above, much paler and semiglossy below, anterior lobe 37–62 cm long, margins usually broadly convex, sometimes straight, occasionally concave; posterior lobes 9–20 cm long; midrib flat, slightly paler, concolorous, and broadly convex on upper surface, raised and paler on lower surface; primary lateral veins 6 to 10 per side, 8 to 20 pairs, arising at sharp angle then spreading at 45–60° angle from midrib, gently curving toward apex, sunken above, raised and darker than surface below; minor veins obscure above, distinct or rarely indistinct below; cross-veins drying distinct; basal veins 2 to 5 per side, 1st pair free to base, 2nd & 3rd pairs often coalesced 1–2 cm; posterior rib short and straight, never naked along sinus; sinus (when present) parabolic to arcuate or subhippocrepiform.

Figure 1. *Philodendron asplundii* Croat & M. L. Soares. Clockwise from top left. —Habit (*Croat 49444*, type). —Stem showing petioles and persistent cataphylls (*Croat 49444*, type). —Habit showing cluster of inflorescences with one open; leaf form with prominent sunken primary lateral veins (*Croat 49605*). —Leaf form with weakly sunken primary lateral veins (*Croat 62327*).

Figure 2. —Left. Petiole bases, cataphylls, and inflorescences (*Croat 75398*). —Right. Close-up of spadix (*Croat 75398*).

INFLORESCENCES up to 8 per axil; peduncles (3.0)8.0–15.5 cm long (av. 10.1 cm), 7–10 mm (drying 3–8 mm) diam., terete to weakly flattened, conspicuously striate, erect to somewhat spreading, green with paler streaks, white at base, tinged red; spathe 8–14.5(17) cm long, tapering toward apex with spathe sometimes turned upward from peduncle; spathe tube 3–5.3 cm long, 2–3.6 cm diam., green to pale green with white streaks outside, whitish to pale green or light red inside with translucent resin canals, these eventually with pale yellow resin in lower 2/3 of tube; spathe blade white to yellowish white, sometimes bent backward about midway at anthesis (*Croat 49605*); spadix 7.5–13 cm long, female portion 1.9–2.2 cm long, 1.2–1.4 cm diam., greenish white to white or pale yellow-green; male portion creamy-white to white, 3.5–8.5 cm long, 1 cm diam. 1 cm above base, 7 mm diam. 1 cm below tip; sterile male portion ca. 1 cm long, 1.4–1.6 cm diam.; sterile male flowers 1.75 mm long, 1.75 mm diam., fertile male flowers 1.5–2.4 mm long, 1.3–1.5 mm diam., narrowed toward base, stamens 3 to 5 per flower; pistils 1.5–3 mm long, 1–2 mm diam., 4- to 6-locular, drying dark tan; style 0.6–0.8 mm long, 1.25 mm diam.; stigma depressed-globular, 1–1.2 mm high; style irregularly circular in outline with a central indentation and usually 4 to 6 indentations in a circle around a central pore (these corresponding to the usual number of locules), drying shield-like, ca. 2 mm diam., extending slightly over margin of ovary; locules 4 to 7 per ovary, 2.1 mm long; ovules hemi-anatropous, ca. 25 per locule, 0.4–0.5 mm long; axile placentation, biseriate: funicle 0.3–0.4 mm long. INFRUCTESCENCE with berry yellowish to orangish or greenish white, seeds 1 mm long, 0.5 mm wide, with 8 to 10 longitudinal striations (ridges), narrowing near chalazal end, drying tan.

Philodendron asplundii is restricted to the Amazon basin and ranges from southern Venezuela (Amazonas) and French Guiana to Brazil (Acre, Amazonas), Colombia (Putumayo, Amazonas, Caquetá), Ecuador (Sucumbíos, Napo, Pastaza, Morona-Santiago), and Peru (Amazonas, Loreto, San Martín, Huanuco, Pasco) at 150–2500 m elevation in *Tropical moist forest (T-mf)* and *Premontane wet forest (P-wf)* (apparently preferring the latter based on the number of collections). Life zone classifications are after Holdridge (1967).

Philodendron asplundii is a member of *Philodendron* subg. *Philodendron* sect. *Philodendron* and

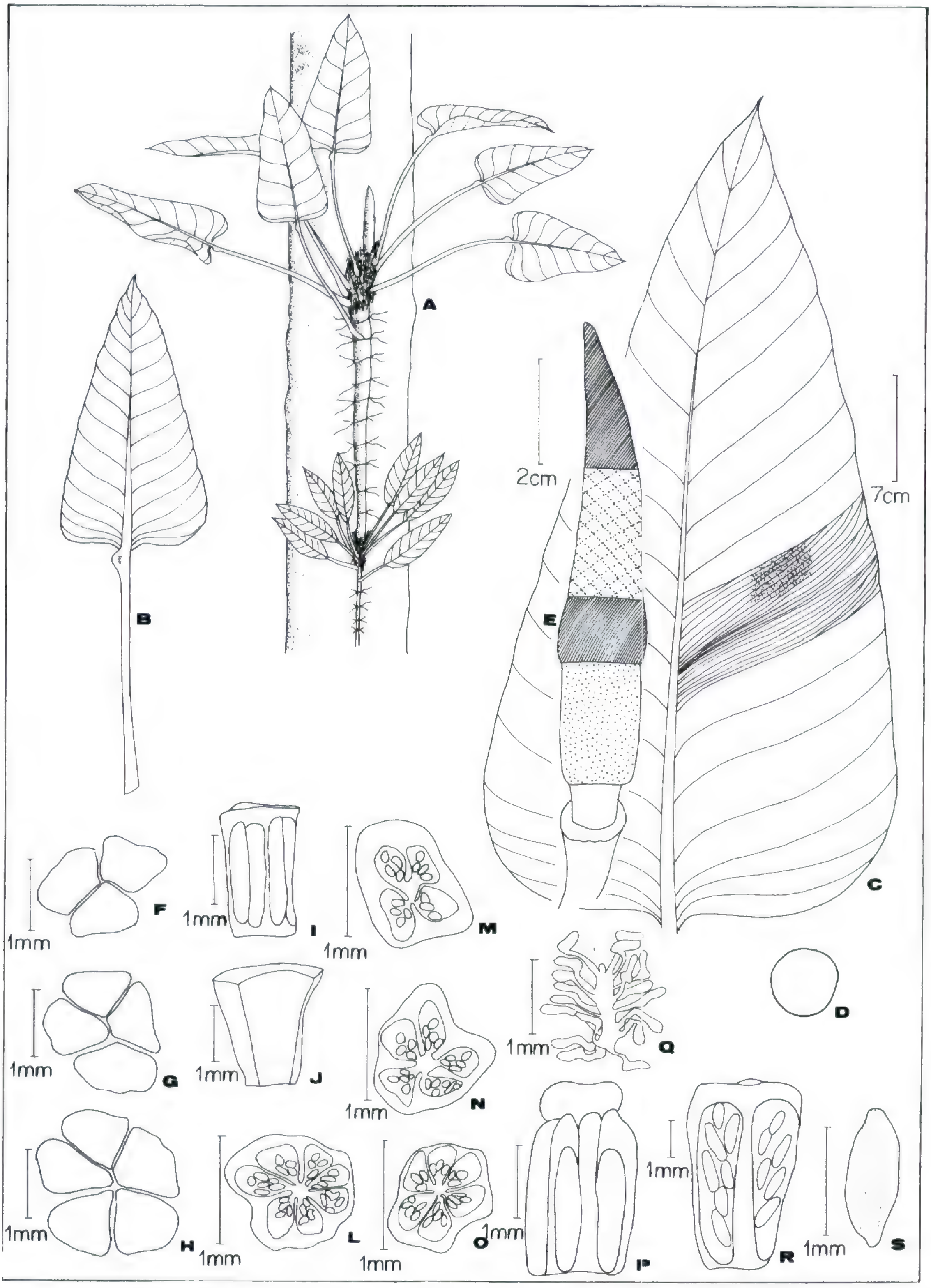


Figure 3. *Philodendron asplundii.*—A. Habit. —B. Leaf. —C. Leaf blade showing details of venation. —D. Petiole in cross section. —E. Inflorescence with spathe removed in face view showing (basipetally) apical sterile portion, fertile staminate portion, sterile staminate portion, pistillate portion, stipe, spathe scar and peduncle. —F–H. Apical view of staminate flowers. —I. Face view of stamens. —J. Face view of staminoid. —L–O. Cross sections of ovaries showing 7, 4, 5, and 6 locules. —P. Longitudinal section of gynoecium. —Q. Placenta with funicles and ovules. —R. Longitudinal section of berry. —S. Seed. Drawing by M. L. C. Soares.

is highly variable in blade shape. It can be distinguished by the prominent cross-veins visible on fresh veins, which are especially noticeable upon drying, and by the sharply D-shaped to sharply 2-ribbed cataphylls, which persist as fine fibers and epidermal fragments. It is most closely related to *P. colombianum* R. E. Schultes, which differs by being terrestrial, having smaller, nearly rounded blades, a V-shaped sinus, and smaller inflorescences with shorter, more globular spathe tubes.

The species was first collected in 1929 by E. P. Killip and A. C. Smith in the Río Huallaga valley in the Loreto Department of Peru and was next collected by Eric Asplund in 1956 in Ecuador. Since existing names in *Philodendron* preclude using the names of either Killip or Smith, the species is named in honor of Eric Asplund. Asplund was one of the earliest collectors in Ecuador and was responsible for collecting many new species of Araceae.

One collection (*Holm-Nielsen et al. 22723*) referred to the inflorescence as being red, which seems highly unlikely for this species.

Paratypes. BRAZIL. **Acre:** Serra da Moa, *Prance et al. 12163A* (NY); Rio Javari, behind Palmeiras Army Post, 5°08′S, 72°49′W, *Lleras et al. P16991* (NY); road between Cruziero do Sul and Rio Branco, 44 km E of Cruzeiro do Sul, Fazenda da Dona Cabuca, 7°38′S, 72°35′W, 150 m, *Croat 62327* (CM, K, MEXU, MO, US). **Amazonas:** Manaus, Reserva Florestal Ducke, Área 10, campina 1, próximo ao marco 517, *Soares & Silva 196* (INPA); Barro Branco, *Soares & Silva 205* (INPA), *Soares et al. 251* (INPA), *Soares et al. 272* (INPA); extremo da Reserva, *Soares & Silva 217* (INPA); Acará, atrás do Acampamento ca. 500 m, próximo ao Igarapé, *Soares & Silva 228* (INPA). COLOMBIA. **Putumayo:** Macoa, along S bank of Río Macoa, 1°10′N, 76°33′W, 700 m, *Croat 51741* (MO, COL). **Amazonas:** 7 km N of Leticia near road, 100 m, *Plowman 2444* (F, GH, K). **Caquetá:** Florencia, 420 m, *Perez Arbelaez 713* (US). ECUADOR. **Morona-Santiago:** road between Macas and Puyo, 31 km N of Macas, 28.5 km N of bridge over Río Upano, 2°01′S, 77°56′W, 1125 m, *Croat 72795* (COL, HUA, MO, NY, US); road between Gualaquiza and Zamora, 5 km S of El Pangui, 4°21′S, 78°50′W, 800 m, *Croat 50815* (JBGP, MO). **Napo:** vía Coca–Lorento–Hollín, sitio Huaticocha, 00°45′S, 77°29′W, 500 m, *Palacios et al. 3570* (MO); Estación Biológica Jatun Sacha, Río Napo, 8 km al E de Misahuallí, 1°04′S, 77°36′–37′W, 400–450 m, *Palacios 2984* (MO), *2995* (MO), *7082* (MO, QCNE), *Palacios et al. 4919* (MO, QCNE), *Croat 73409* (JBGP, MO, QCNE, SEL, VDB), *Cerón 686* (MO, QCNE), *849* (MO, QCNE), *1331* (MO, QCNE), *1972* (MO, QCNE), *3578* (MO, QCNE), *Gentry et al. 60119* (MO); Añangu, Río Napo, 00°31′S, 76°23′W, 260 m, *Lawesson et al. 39670* (QCA); Reserva de Producción Faunística Cuyabeno, N of Laguna Grande, 00°1′S, 76°11–12′W, 265–300 m, *Nielsen 76338* (AAU), *76429* (AAU), *76576* (AAU), *Poulsen 78490* (AAU), *80405* (AAU), *80730* (AAU), *Brandbyge et al. 36138* (MO); Puerto El Carmen de Putumayo (on Río Putumayo at Colombian frontier)–Lago Agrio, vic. of Tarapoa, 76 km E of Lago Agrio, 00°07′N, 76°23′W, 240 m, *Croat 58628* (MO, QCA, VDB); Baeza–Lago Agrio, vic. km marker 100, 43.2 km W of Lumbaqui, 20.4 km E of Estación Bomba CEPE Saltado, 70.9 km E of Baeza turnoff, 00°07′S, 77°36′W, 1460 m, *Croat 58726* (K, MO, QCA); 72.5 km W of Lago Agrio, 1166 m, *Croat 49519* (MO), *49542* (CM, MO); Río Oyacachi, 00°20′S, 77°55′W, 1620 m, *Croat 50293* (MO, OOM, W); km 154.5 W of Lago Agrio, 1730 m, *Croat 49432* (MO), 760 m, *Croat 49510* (MO); 39 km NE of jct. of road to Tena, 19.7 km NE of El Chaco, 141 km SW of Lago Agrio, 1750 m, *Croat 58538* (L, MO, QCA); Canton El Chaco, márgen derecha del Río Quijos, Finca "La Ave Brava" de Segundo Pacheco, 00°12′S, 77°39′W, 1800–1900 m, *Palacios 5427* (MO); Baeza–Tena, km 68, only a few km S of Baeza, 00°30′S, 77°56′W, 2000 m, *Croat 50495* (MO, VEN); 40 km N of Archidona, 00°41′S, 77°41′W, 2000 m, *Croat 50522* (MO); 31.9 km N of Archidona, 1660 m, *Croat 49605* (MO), *49610* (MO); 72 km N of Archidona, 2000 m, *Croat 49546* (CM, MEXU, MO); Baeza, 2000 m, *Besse et al. 1505* (SEL); Reserva Etnica Huaorani, Maxus Oil Pipeline Rd., km 116, Pozo Iro, km 4, 1°04′S, 76°12′W, 240 m, *Aulestia & Mipo 3398* (MO, QCNE); Parque Nacional Yasuní, Maxus Oil Pipeline Rd., km 32, al sur del Río Tiputini, 00°37′S, 76°29′W, 250 m, *Aulestia 1665* (MO, QCNE); E of Estación Científica Yasuní, 00°40′S, 76°23′W, 200–20 m, *Aulestia 43* (AAU); 200–250 m, *Aulestia 32* (AAU, MO); 00°40′S, 76°22′W, 230 m, *Aulestia 209* (AAU); Río Napo, 00°28′S, 76°40′W, 250 m, *Aulestia 1808* (COL, MO, RSA, QCNE); Yasuní, Añangu, 00°31′S, 76°23′W, 270 m, *Luteyn et al. 8999* (MO); Yasuní, Oil Pump Amo 2, 00°52′S, 76°05′W, 230 m, *Cerón & Coello 3218* (MO, QCNE); 00°57′S, 76°13′W, 230 m, *Palacios 2423* (MO, QCNE); Yasuní, 1–3 km E of Pontificia Universidad Católica del Ecuador Science Station, by Tiputini River, 00°53′S, 76°23.7′W, 240 m, *Acevedo-Rdgz. & Cedeño 7341* (US); Coca (San Francisco de Orellana), *Croat 75398* (MO), *78420* (MO); Coca–Río Tiguino, 85.8 km S of Coca and bridge over Río Napo, 1°10′S, 76°52′W, 300 m, *Croat 72563* (K, KRAM, MO); Lago Agrio–Francisco de Orellana (Coca), 4.7 km N of Coca, 00°28′S, 76°58′W, *Croat 50407* (MO); Hacienda Cotapino (Concepción), 550 m, *Harling et al. 7126* (GB, MO); Proyecto Hidroeléctrico Coca, Punto ST4, Río Quijos, 10 km S of Reventador, 00°08′S, 77°30′W, 1450 m, *Palacios 6056* (AAU, MO, QCNE); Punto ST3, along Río Quijos, 10 km S of Reventador, 00°11′S, 77°39′W, 1500 m, *Palacios 5889* (MO, QCNE); creek 3.5 km NW of Borja, 00°24′S, 77°50′W, 1850 m, *Holm-Nielsen et al 26341* (AAU); Tena, *Harling 3666* (S); Río Aguarico, 60 km downstream from San Pablo de Los Secoyas, 00°18′S, 76°W, 220 m, *Holm-Nielsen et al. 21143* (AAU); Misahuallí, 00°03′S, 77°35′W, 500 m, *Hammel 15987* (MO). **Napo-Pastaza:** Vera Cruz, 900 m, *Asplund 19427* (S). **Pastaza:** Río Curaray, 2 km W of school, 1°22′S, 76°58′W, 250 m, *Holm-Nielsen et al. 21811* (AAU); SE of airstrip, 1°22′S, 76°57′W, 250 m, *Holm-Nielsen et al. 22244* (AAU); Río Curaray, Valle de la Muerte, 1°25′S, 76°52′W, 240 m, *Holm-Nielsen et al. 22498* (AAU); Río Villano, Ceiba, 1°25′S, 77°02′W, 260 m, *Holm-Nielsen et al. 22723* (AAU); Montalvo, 0–1 km NE of military camp, 2°05′S, 76°58′W, 250 m, *Lojtnant & Molau 13350* (AAU); carretera de PETRO-CANADA, vía Auca, 115 km S of Coca, 6 km S of Río Tigüino, 1°15′S, 76°55′W, 320 m, *Zak & Rubio 4209* (MO, QCA, QCNE); road to Tarabita and portage over Río Pastaza, 3 km from turnoff from main Puyo–Mera Road, 1000 m, *Croat 49701* (MO). **Sucumbíos:** Lago Agrio–Puerto El Carmen de Putumayo (at Río

Putumayo on Colombian frontier), 91.7 km SE of Lago Agrio, 63.1 km SE of Dureno, 15.3 km E of Tarapoa, 00°08′S, 76°23′W, 260 m, *Croat 58574* (G, MO, QCA); Reserva Faunistica Cuyabeno, N of Laguna Grande, 00°01′N, 76°11′W, 265 m, *Balslev et al. 84621* (AAU, MO); Reserva Faunistica Cuyabeno S of Laguna Garzacocha, 00°01′S, 76°11′W, 265 m, *Balslev et al. 84693* (AAU); trail to Volcán El Reventador, from km 100 on Baeza–Lago Agrio Highway, 1900 m, *Jaramillo & Grijálva 12959* (NY); Gonzalo Pizarro Canton, campo Bermejo 6 Norte, 30 km NE of Lago Agrio, 00°14′N, 77°13′W, 1050 m, *Cerón et al. 9335* (MO, QCNE, US). FRENCH GUIANA. Grand Saut along Armontabo River affluent to Oyapock River, *Prévost 1906* (CAY). PERU. **Amazonas:** Bagua: Quebrada chichijam entsa, Río Cenepa, Monte, 920 m, *Ancuash 582* (MO); 4°55′S, 78°19′W, 320 m, *Jaramillo et al. 1164* (MO); Huambisa, Valle del Río Santiago, 65 km N de Pinglo, Quebrada Caterpiza, 2–3 km atras de la comunidad de Caterpiza, 3°50′S, 77°40′W, 200 m, *Tunqui 297* (MO), *856* (MO), *Huashikat 1807* (MO), *2061* (MO). **Huanuco:** Leoncio Prado, Tingo María, hills W side of Río Huallaga, 700 m, *Solomon 3390* (MO); Distrito Rupa Rupa, Jacintillo, Río Monzón, 680–700 m, *Schunke 10372* (CM, F, MO). **Loreto:** Alto Amazonas, Balsapuerto (lower Río Huallaga basin), 150–350 m, *Killip & Smith 28623* (F, NY, US), *28688* (NY, US); Santa Rosa, lower Río Huallaga below Yurimaguas, 135 m, *Killip & Smith 28815* (US), *28865* (NY); 2°55′S, 76°25′W, 180 m, *Vásquez et al. 2981* (MO). Maynas: 14 km SW of Iquitos, *Croat 18510* (MO); Laguna Quistacocha, 15 km, SW of Iquitos, *Solomon 3421* (MO); Iquitos, Puerto Almendra, 3°48′S, 73°25′W, 120 m, *Croat 51200* (MO), *51206* (MO); 120 m, *Revilla 3555* (MO); Asociación Agraria Paujil, 4°10′S, 73°20′W, 150 m, *Vásquez & Jaramillo 10806* (MO); Buena Suerte, (Río Itaya), *Vásquez & Jaramillo 8419* (MO); Allpahuayo, Estación Experimental del Instituto de Investigaciones de la Amazonia Peruana, 4°10′S, 73°30′W, 150–180 m, *Vásquez & Jaramillo 16369* (MO); Iquitos, km 44 carretera Iquitos–Nauta, terrenos del Comité de Reforestación Iquitos, 4°10′S, 73°20′W, 150 m, *Vásquez et al. 11969* (MO, NY, USM); carretera de Zungaro Cocha, Quebrada Shushuna, 120 m, *Rimachi 11277* (IBE); Sargento Lores, Esperanza (Río Tahuayoz), 4°10′S, 73°15′W, 120 m, *Vásquez & Jaramillo 13246* (MO); 4 km from Mishana, Río Nanay, Estación Biológico Callicebus, 150 m, *Gentry et al. 15829* (MO); Puerto Almendra at Río Nanay, *Croat 18358* (MO); Dtto. Las Amazonas, Explornapo Camp Sucusari, subparcels 18–22, MacArthur Inventario, near Río Napo, 3°20′S, 72°55′W, 100–140 m, *Pipoly et al. 13035* (MO), *13047* (MO), *13722* (MO), *14524* (MO), *Vásquez & Jaramillo 16030* (MO); Pto. Almendras, (CIEFOR), 3°48′S, 73°25′W, 122 m, *Vásquez & Jaramillo 6617* (MO); Dtto. Indiana, Quebrada Yanayacu, trail from Monte Carmelo to Manati, *McDaniel et al. 21590* (IBE); Requena, Jenaro Herrera, Río Ucayali, 4°55′S, 73°45′W, *Gentry et al. 56648* (MO); 4°50′S, 73°45′W, 170 m, *Vásquez et al. 2066* (MO); Río Ucayali below Requena, *Gentry et al. 21357* (F, MO, USM); 5°05′S, 73°50′W, 180 m, *Vásquez & Jaramillo 4722* (MO). **Pasco:** Oxapampa, drainage of Río Palcuazu between km 51 and 60 of new road NW of Villa Rica toward Puerto Bermudez, 10°30′S, 75°5′W, 700 m, *Gentry & Smith 36030* (MO); Palcazu valley, Cabeza de Mono, 5–6 km W of Iscozazin, 10°12′S, 75°14′W, 325 m, *Smith 3742* (MO); 10°12′S, 75°15′W, 380 m, *Foster 7929* (MO, USM); N of Iscozazin River just below native community of Alto Isco, *Salick 6128* (MO). **San Martín:** Lamas, Alonso de Alvarado, San Juan de Pacaizapa, km 72 carretera Tarapoto–Moyobamba, 1000–1050 m, *Schunke 9620A* (CM, MO): Mariscal Caceres, Uchiza, Azpuzana, near San Martín-Huanuco border, 500 m, *Plowman 5936* (GH); San Martín, road from Moyobamba to Chachapoyas, km marker 447 (447 km E of Olmos), N of Rioja, Rioja–Naranjos, 5°55′S, 77°13′W, 700 m, *Croat 58147* (MO, USM), *58154* (CM, K, MO, USM); Tarapoto–Yurimaguas, 10.6 km from junction in road to Río Huallaga, 6°30′S, 76°21′W, 530 m, *Croat 58108* (CAS, MO, RSA, SEL, USM). VENEZUELA. **Amazonas:** upper Río Yaciba between Base Camp and White-Water affluence, 100–140 m, *Maguire et al. 37445* (NY).

Philodendron heleniae subsp. **amazonense** Croat, subsp. nov. TYPE: Ecuador. Napo: Parque Nacional Yasuní, Pozo Petrolero Daimï, 00°55′S, 76°11′W, 26 May–8 June 1988, *C. E. Cerón & Hurtado 4246* (holotype, MO–3636060; isotypes, K, QCNE, US). Figure 4.

Planta plerumque hemiepiphytica, raro terrestris; internodiis 1–7(10) cm longis, 1.0–2.5 cm diam.; cataphyllis 11–16 cm longis, acute 2-costatis, deciduis. Folium petiolo tereti vel D-formi, 8.5–29.0 cm longo, 6–8 mm diam.; lamina anguste ovata vel oblongo–elliptica, 34–55 cm longa, (16)18–25 cm lata, in sicco flavidobrunnea vel viridigrisea. Inflorescentiae 1 ad 5 in quoque axilla, pedunculo 2–7.5 cm longo, 4–6 mm diam.; spatha 4–10 cm longa, viridi vel alba. Ovarium (5- ad) 6- ad 9-loculare; ovulis (1 ad) 3 vel 4 in quoque loculo.

Usually hemiepiphytic, rarely terrestrial; vining or appressed-climbing; stem appressed-climbing to somewhat scandent; internodes smooth, 1–7(10) cm long, 1.0–2.5 cm diam., as broad as long or much longer than broad, flattened on one side with sharp to blunt marginal ridges, matte, gray-green, turning brown, drying reddish brown, the epidermis smooth or irregularly folded and ridged, drying with longitudinal folds, sometimes peeling free upon drying; cataphylls 11–16 cm long, sharply 2-ribbed, green, deciduous; petioles 8.5–29.0 cm long, 6–8 mm diam., ± terete to D-shaped, obtusely flattened and weakly sulcate adaxially, firm, medium green, drying reddish brown; blades narrowly ovate to oblong-elliptic, subcoriaceous, strongly bicolorous, acuminate at apex, usually weakly and unequally subcordate, sometimes obtuse, truncate or rounded at base, 34–55 (av. 45.4) cm long, (16)18–25 (av. 19.8) cm wide, 1.8–2.8 times longer than wide (av. 2.3); upper surface dark green, semiglossy, drying smooth and yellow-brown to gray-green, lower surface much paler, weakly glossy to matte, drying yellowish to reddish brown, the secretory canals typically only visible on very young leaves; sinus broadly V-shaped to arcuate or lacking, to 1.5 cm deep when present; midrib flat to broadly convex, pale green above, bluntly acute and thicker than broad, slightly paler than surface below; basal veins lacking; primary lateral veins 6 to 10 per side, de-

Figure 4. *Philodendron heleniae* subsp. *amazonense* Croat. Clockwise from top left. —Habit (*Croat 49632*). —Stem close-up showing petiole bases and cataphyll scars (*Croat 49632*). —Leaves in face view (*Croat 49632*). —Stem with leaf axils and two inflorescences (*Croat 58986*).

parting midrib at a 40–60° angle, weakly sunken above, weakly raised and darker than surface below; minor veins weakly visible, arising from the midrib only, the surface smooth below. INFLORESCENCES 1 to 5 per axil; peduncle 2–7.5 cm long, 4–6 mm diam., green, obtusely flattened on one side; spathe greenish or white throughout, whitish on inner surface, semiglossy, cuspidate at apex, sometimes blade white and tube green, 4–10 cm long, up to 5 mm diam.; spadix sessile, slightly shorter than the spathe; pistillate portion pale green to creamy white, extending to 2/3 the length of spadix shortly after anthesis; pistils (5)6- to 9-locular; locules (1)3- to 4-ovulate; staminate portion cream to white, cylindrical or clavate. INFRUCTESCENCE unknown.

Philodendron heleniae ranges from Panama to Ecuador, from 20 to about 1040(–1450) m elevation. *Philodendron heleniae* subsp. *heleniae* ranges down the Pacific slope of South America. *Philodendron heleniae* subsp. *amazonense* is endemic to the Amazon basin ranging from Ecuador (Morona-Santiago, Napo, Pastaza, Sucumbíos) to Peru and Bolivia at 200 to 1000 m elevation in *Tropical moist forest (T-mf), Tropical wet forest (T-wf),* and *Premontane wet forest (P-wf).* It differs from *P. heleniae* subsp. *heleniae* in having generally fewer inflorescences per axil, usually white rather than reddish spathes, smooth rather than coarsely pustular lower blade surfaces, and the near lack of secretory cells in mature leaves.

Philodendron heleniae subsp. *amazonense* is a member of *Philodendron* subg. *Philodendron* sect. *Calostigma* subsect. *Oligocarpidium.* It is characterized by its scandent habit, the reddish brown-drying internodes much longer than broad, subterete petioles, narrowly ovate, subcordate, yellow-brown-drying blades and clusters of up to 5 small whitish inflorescences.

Paratypes. BOLIVIA. **Cochabamba:** Carrasco, Parque Nacional Carrasco, 17°23′S, 64°30′W, 525 m, *Acebey 531* (LPB, MO). COLOMBIA. **Amazonas:** Leticia, Parque Nacional Natural Amacayacu, Quebrada de Agua Pudre, 1.5 km NE of mouth of Amacayacu River, 3°47′S, 70°15′W, 200–220 m, *Pipoly 15892* (MO, NY). ECUADOR. **Morona-Santiago:** Plan Del Milago at crossroad between Limón and Indanza, 1600–1700 m, *Harling & Andersson 24568* (GB); Pozo petrolero "Garza" del Tenneco, 35 km (approx.) N of Montalvo, 1°49′S, 76°42′W, 260 m, *Zak & Espinoza 4549* (MO, QCNE). **Napo:** Jatun Sacha Biological Station, Río Napo, 8 km E of Misahuallí, 1°04′S, 77°36′E, 450 m, *Cerón 977* (COL, JAUM, MO, QCNE), *1756* (MO, QCA, QCNE), *3632* (MO, QCNE), *3742* (AAU, GB, MO, QCNE), *Neill 8701* (MO, QCNE), *Cerón 4567* (MO, QCNE); Parque Nacional Yasuní, La Joya de los Sachas, Maxus Oil pipeline road, km 45, 00°45′S, 76°28′W, 230 m, *Dik 91* (B, MO, QCNE); Yasuní, Conoco oil pump "Daimi II," 00°09′S, 76°12′W, 240 m, *Coello 318* (MO, QCNE); Yasuní, 00°55′S, 76°11′W, 200 m, *Cerón & Hurtado 3854* (MO, NY, QCNE, WU); Yasuní, Pozo Amo 2, 00°52′S, 76°05′W, 230 m, *Cerón 3360* (MO, QCNE); Yasuní, Alrededores del Helipuerto de Amo Sur, 00°52′S, 76°05′W, 230 m, *Cerón 3422* (MO); W of Alinhuahi, Cocha, 1°02′S, 77°35′W, *Bennett 4526* (MO); Tena to past Muyuna, 2 km W of Muyuna, ca 5.7 km W of Tena, 00°01′S, 77°51′W, 500 m, *Croat 58860* (MO, QCA); Tena to Puyo, 58.1 km N of Puyo, 600 m, *Croat 49632* (F, MO); Canton Tena, Río Blanco community, headwaters of Río Huambuno, 6 km NNW of Ahuano, 1°S, 77°40′W, 440 m, *Kohn 1170* (MO, WIS); Lago Agrio to Francisco de Orellano (Coco), 15 km N of Coco, 00°30′S, 76°56′W, 450 m, *Croat 50415* (MO); Limococha, 240 m, *Madison et al. 5458* (SEL); Río Napo, *Asplund 10248* (S). **Pastaza**: Namoyacu at Río Curaray, 1°27′S, 76°47′W, 230 m, *Holm-Nielsen et al. 22315* (AAU), *22317* (AAU), *22359* (AAU, MO), *22366* (AAU); road towards Canelos, 6 km E of Puyo Macas road, 25.7 km S of Puyo, 1°34′S, 77°46′W, 800 m, *Thomas & Rios 6708* (MO, NY); along road to Canelos, (departing main Puyo–Macas road at 32 km from Puyo, 22.5 km S of Veracruz) 3.8 km from turnoff, near maintainence camp, 1°37′S, 77°51′W, 850 m, *Croat 58986* (MO, QCA); Canton, Arco Oil pump "Moretechocha," Río Landayacu, 75 km E of Puyo, 1°34′S, 77°25′W, 580 m, *Gudiño 1160* (MO, QCNE); along road to Tarabita and portage over Río Pastaza, 3 km from turnoff from main Puyo–Mera Road, 1000 m, *Croat 49682* (MO). **Sucumbíos:** Lago Agrio (Nueva Loja) to Coca (Pto. Francisco de Orellana), 26 km S of Lago Agrio, 4.6 km S of El Emo, then 2.8 km W of main Lago Agrio–Coca Road, 00°05′S, 76°54′W, 355 m, *Croat 72528* (CM, MO, QCNE); Lumbaqui to Bonita, a few km N of Lumbaqui, *Croat 81429.* PERU. Plantación Margarita near Divisoria, 1500–1600 m, *Ferreyra 1046* (MO, USM). **Amazonas:** Bagua, Cenepa, Nuevo Nazareth, near mouth of Río Imaza, on Río Marañon, 250–300 m, *Tillett 671–30* (GH, MYF); Bagua, Imaza, Comunidad Aguaruna de Kusú-Litra, Cerro Apág, Quebrada Kusú, 600–700 m, *Diaz et al. 8260* (MO, WU); Monte Virgen, 800 m, Communidad de Caterpiza, Quebrada Caterpiza, Río Santiago, 200 m, *Huashikat 485* (MO); Río Santiago, vic. de Caterpiza 180 m, *Huashikat 760* (MO); upper Río Cenepa, Shimpunts, *Kayap 409* (MO); N of Cenepa above Chikan, 600–800 ft., *Berlin 1807* (MO). **Huánuco:** Pachitea, Puerto Inca, carretera marginal 14 km from a point across the Río Pachitea from Puerto Inca, 9°31′S, 74°58′W, 350 m, *Smith 1302* (MO, USM); Comunidad Nativa Santa Marta (about 50 km by river from Puerto Inca) on the bank of Sungaruyacu, 9°20′S, 75°15′W, 360 m, *Smith 1233* (MO). **Loreto:** Loreto, Explorama Lodge Tourist Camp, Yanamono, 3°28′S, 72°50′W, 140 m, *Gentry et al. 72083* (MO); 12 km SW of Iquitos, *Croat 20085* (MO). Maynas: Río Amazonas, Isla de Aguajal, ca. 2 hrs. from Tamshiyacu, 110 m, *Rimachi 8775* (IBE, MO), *8813* (IBE, USM); carretera Iquitos, km 60, 4°10′S, 73°30′W, 150 m, *Ruiz 1186* (MO); vicinity of Quistococha, 200 m, *Gentry et al. 22296* (F, MO, NY); Sargento Lores, Constancia Norte, 4°07′04″S, 72°55′17″W, 116 m, *Vasquez et al. 23430* (MO).

Acknowledgments. Special thanks go to Maria de Lourdes da Costa Soares Morais from the INPA Herbarium, Manaus, coauthor of *Philodendron asplundii,* for the line drawing used for this publication, and for much of the detail provided for the description of the ovary, locules, and ovules.

Literature Cited

Holdridge, L. R. 1967. Life Zone Ecology. Tropical Science Center, San José, Costa Rica.

Two New Species of *Paspalum* (Poaceae: Panicoideae) from Brazil

Gerrit Davidse
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

Osvaldo Morrone and Fernando O. Zuloaga
Instituto de Botánica Darwinion, Casilla de Correo 22, San Isidro (B1642HYD), Argentina

ABSTRACT. Two new endemic species, *P. cachimboense* from Mato Grosso and *P. goyasense* from Distrito Federal and Goiás, Brazil, are described, illustrated, and compared with putatively related species. Keys to the new species and related taxa of *Paspalum* subg. *Ceresia* are also presented.

Key words: Brazil, *Paspalum*, Poaceae, South America.

Paspalum L. is a large genus with approximately 330 species. Most of the species grow in the Americas, in tropical and subtropical areas; the genus is particularly abundant in Brazil (Chase, 1929; Pohl, 1980).

During revision of the American species of *Paspalum*, examination of several specimens, collected in central Brazil, revealed the existence of two new species. Both species are here described, illustrated, and compared with species previously included in subgenus *Ceresia* (Persoon) Reichenbach (Chase, 1929, ined.). It should be pointed out that an effort was made to locate specimens of both new species in Brazilian herbaria, such as CEPEC, INPA, R, RB, SP, without success.

Paspalum cachimboense Davidse, Morrone & Zuloaga, sp. nov. TYPE. Brazil. Mato Grosso: Mun. Colider, estrada Santarém–Cuiabá, BR-163, km 762, Serra do Cachimbo a 30 km da cidade de Guarantã, 09°35′S, 54°55′W, 19 abr. 1983, cerrado, campo aberto, solo pedregoso, *M. N. Silva, I. L. Amaral, J. Lima, O. P. Monteiro & J. Coêlho 24* (holotype, MO). Figure 1.

Paspalo lancifloro Trinius simile sed gramine annuo, culmis profuse ramificantibus, rhachidi 2–3 mm lata, spiculis 4–4.3 mm longis, anthoecio supero 2.2–2.5 mm longo differt.

Annual, with geniculate *culms* 20–60 cm tall, profusely branching at the middle and upper nodes; internodes 5–11 cm long, terete, glabrous; nodes brownish, glabrous. Sheaths 5–8 cm long, usually shorter than the internodes, rounded at the back and keeled toward the distal portion, papillose-pilose in the upper portion, otherwise glabrous, the margins membranous. *Ligules* 2–3 mm long, hyaline, membranous, glabrous; pseudoligule absent; collar papillose-pilose. *Blades* linear, 14–19 cm long, 0.4–0.6 cm wide, flat, rounded at the base, the apex acuminate, densely papillose-pilose on both surfaces, the margins ciliate. *Peduncles* terminal, long-exserted, filiform, up to 20 cm long, terete, glabrous. *Inflorescences* fasciculate, 5–7 cm long, 2–5 cm wide; main axis absent; pulvini pilose, with a short to lanceolate bract, up to 5 mm long; racemes 1 to 4, solitary to pseudoverticillate, ascendent and divergent, ending in a naked point; rachis of the branches foliaceous, 5–7 cm long, 2–3 mm wide, glabrous, the midnerve purplish and wings hyaline, glabrous; spikelets solitary and imbricated, arranged in 2 series. *Spikelets* long ellipsoid, 4–4.3 mm long, 1.1 mm wide, acute, papillose-pilose, pale and tinged with purple. *Lower glume* absent. *Upper glume* as long as the spikelet, 3-nerved, one nerve central and the other two nerves marginal, papyraceous, with a tuft of whitish hairs, up to 1 mm long, at the base, otherwise glabrous, the base rounded, the margins ciliate on the upper portion, glabrous on the rest of the surface. *Lower lemma* glumiform, as long as the spikelet, 3-nerved, pilose along the lower margins and with papillose-pilose hairs, up to 2 mm long on the upper third of the lemma, otherwise glabrous, sulcate between the nerves and papillose in the lower half. *Lower palea* and *lower flower* absent. *Upper anthecium* long ellipsoid, 2.2–2.5 mm long, 0.8 mm wide, 1–3 mm shorter than the upper glume and lower lemma, plano-convex, glabrous, membranous, pale, stipitate, the stipe 0.2 mm long; upper lemma with small papillae all over its surface and prickles, microhairs, and macrohairs toward the distal portion; palea with the apex free, with a texture and ornamentation like that of the upper lemma; lodicules 2, ca. 0.3 mm long, conduplicate, hyaline; stamens 3, the anthers 1.5 mm long, stigma 2, plumose. *Caryopsis* not seen.

The specific epithet alludes to the type locality

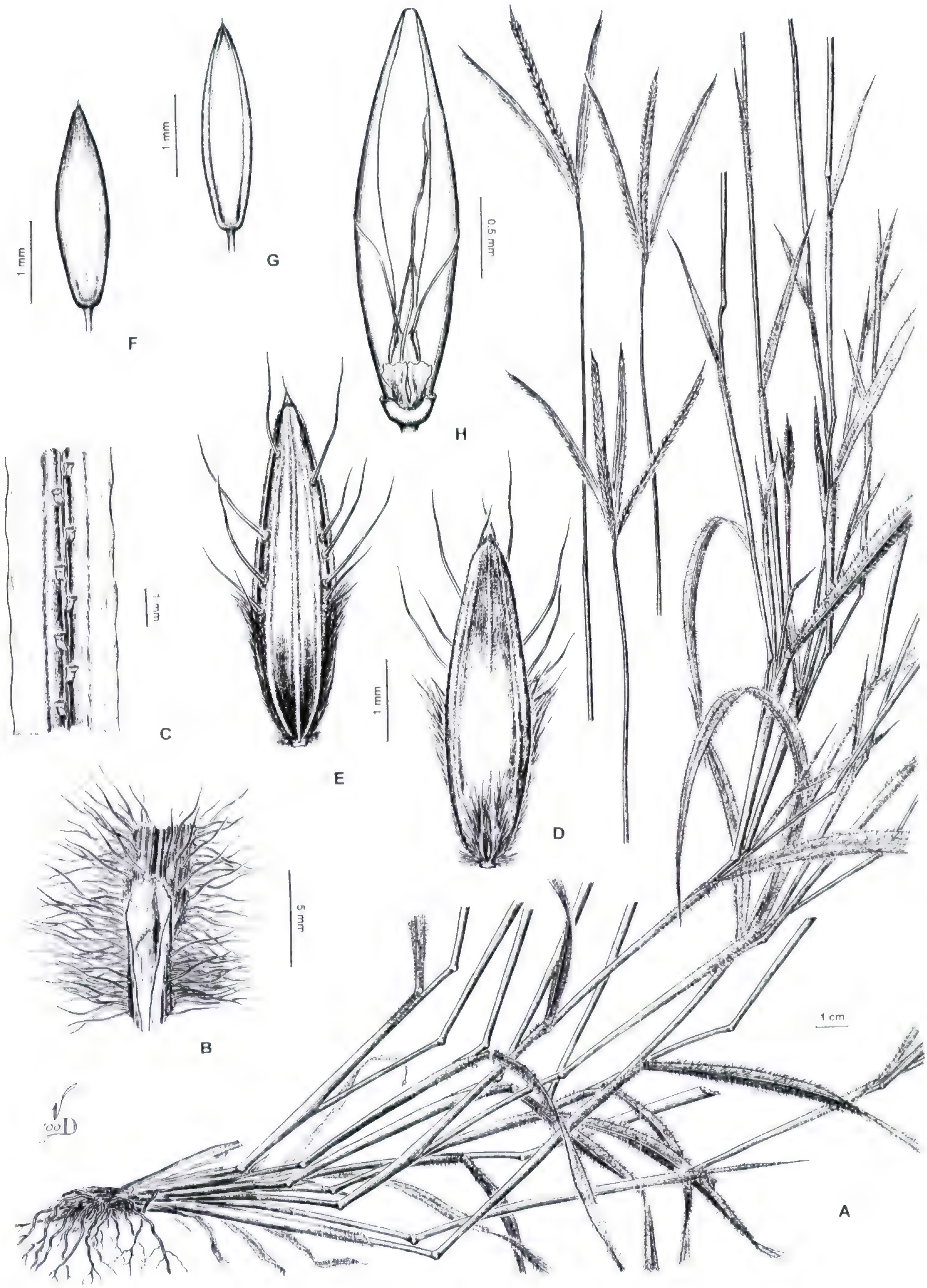


Figure 1. *Paspalum cachimboense* Davidse, Morrone & Zuloaga. —A. Habit. —B. Detail of ligule. —C. Portion of the fertile inflorescence. —D. Spikelet, upper glume view with hairs of the upper lemma on the back. —E. Spikelet, lower lemma view. —F. Upper anthecium, dorsal view. —G. Upper anthecium, ventral view. —H. Upper palea, lodicules, and gynoecium. (Based on *Silva et al. 24.*)

of this new species, Serra do Cachimbo in central Brazil. The Serra do Cachimbo is located between the states of Pará and Mato Grosso and extends, in a NNW-SSE direction, between 7° and 10° of latitude south, with altitudes ranging from 300 to 570 m. The area where *P. cachimboense* grows is a transitional zone between Amazonia and the typical vegetation of the Central Planalto of Brazil (Lleras & Kirkbride, 1978). In this region the soils are poor with low or no agricultural value. They are typically characterized by the presence of whitish quartzite sands (Soembrock, 1966; Eiten, 1975).

According to Lleras and Kirkbride (1978), the specific site location, where the new species was collected, km 762 of BR-163, is a typical "campina" formation, with dominance of trees 4–6 m tall, such as *Pagamea guianensis* Aublet and *Palicourea nitidella* (Müller Argoviensis) Standley (both Rubiaceae); therefore, *P. cachimboense* is probably restricted to quartzite sandy soils of campinas of Amazonia.

This new species belongs to *Paspalum* subg. *Ceresia,* and within this subgenus, to group *Pectinata* (Chase, ined.), by virtue of possessing inflorescences with a reduced number of racemes, rachis of the racemes foliaceous, spikelets solitary and imbricate, and upper glume winged with flat margins. *Paspalum cachimboense* is closely related to *P. lanciflorum,* because both species have spikelets with rounded bases and a stipitate upper anthecium. *Paspalum cachimboense* differs from *P. lanciflorum* by the annual habit of the former (vs. perennial), culms geniculate and conspicuously branched (vs. erect and simple), rachis width 2–3 mm (vs. 5–7 mm), spikelet size 4–4.3 mm (vs. 5.6–7.2 mm), lower lemma with papillae at the lower half (vs. smooth), and upper anthecium length being 2.2–2.5 mm (vs. 3.2–4.7 mm) long.

The annual habit is uncommon within subgenus *Ceresia.* Previously it has only been reported in *P. longiaristatum* Davidse & Filgueiras (Davidse & Filgueiras, 1993), an endemic species of serpentine soils of Goiás, with upper glume and lower lemma aristate.

KEY TO DISTINGUISH *P. CACHIMBOENSE* FROM ALLIED SPECIES OF GROUP *PECTINATA*

1. Spikelets glabrous . . . . . *P. imbricatum* Filgueiras
1′. Spikelets pilose 2
2(1). Spikelets paired, arranged in 4 series; lower lemma without papillose-pilose hairs on the margins . . . . . *P. reticulinerve* Renvoize
2′. Spikelets solitary, arranged in 2 series; lower lemma with prominent papillose-pilose hairs along the margins (except in *P. aspidiotes,* a species with one to several long hairs at the apex) 3
3(2). Upper glume with the base rounded, and with a tuft of dense hairs; upper anthecium stipitate, up to 1/2 as long as the spikelet 4
3′. Upper glume with the base cordate and glabrous; upper anthecium not stipitate, about as long as the spikelet 5
4(3). Annual, with geniculate, profusely branching culms; rachis of the racemes 2–3 mm wide; spikelets 4–4.3 mm long; lower lemma papillose on the lower half; upper anthecium 2.2–2.5 mm long . . . . . *P. cachimboense*
4′. Perennial, with erect, unbranching culms; rachis of the racemes 5–7 mm wide; spikelets 5.6–7.2 mm long; lower lemma smooth; upper anthecium 3.2–4.7 mm long . . . . . *P. lanciflorum*
5(3). Upper glume and lower lemma with 1 to several long hairs at the apex, the margins ciliate, not papillose-pilose; upper glume 7- to 9-nerved; lower lemma scabrous . . . . *P. aspidiotes* Trinius*
5′. Upper glume and lower lemma without long hairs at the apex, the margins papillose-pilose; upper glume 3- to 5-nerved; lower lemma smooth 6
6(5). Plants 0.35–1 m tall; lower sheaths reddish to brownish, shiny; racemes 2(3), 2–8 cm long; spikelets lanceolate . . . . . *P. pectinatum* Nees ex Trinius
6′. Plants 1–1.3 m tall; lower sheaths pale to greenish, not shiny; racemes 5–10, 12–16 cm long; spikelets ovoid . . . . . *P. cordatum* Hackel

**Paspalum setiglume* Chase was recently considered a synonym of *P. aspidiotes* (Zuloaga & Morrone, in prep.).

Paspalum goyasense Davidse, Morrone & Zuloaga, sp. nov. TYPE: Brazil. Goiás: 25 km E of Cabeceiras (ca. 4 km E of Goiás–Minas Gerais border), cerrado and lake margin, 1000 m, 19 Nov. 1965, *H. S. Irwin, R. Souza & R. Reis dos Santos 10524* (holotype, MO). Figure 2.

Paspalo carinato Humboldt & Bonpland ex Flüggé simile sed laminis linearibus, 8–20 cm longis, 0.2–0.4 cm latis, racemis (1–)2(–3), rhachidi 1–1.6 mm lata, gluma superiori dorsaliter pilosa in dimidio inferiori, differt.

Caespitose perennials; *culms* 40–65 cm tall, erect, simple, few-noded; internodes 2 to 3, 6–20 cm long, 0.1 cm diam., terete and hollow, glabrous; nodes brownish, densely pilose. *Sheaths* 3–10 cm long, mostly basal, papillose-pilose or hispid, the margins membranous. *Ligules* 0.5–0.9 mm long, membranous, brownish, glabrous; pseudoligule absent; collar pilose. *Blades* linear, 8–20 cm long, 0.2–0.4 cm wide, mostly basal, flat or with involute margins, ascendent and rigid, rounded at the base, the apex acute, densely papillose-pilose on both surfaces, the margins ciliate. *Peduncles* long-exserted, up to 30 cm long, filiform, pale or tinged with purple. *Inflorescences* terminal, exserted, with 2 racemes, occasionally with a single raceme or with a third raceme present; racemes alternate, as-

Figure 2. *Paspalum goyasense* Davidse, Morrone & Zuloaga. —A. Habit. —B. Detail of ligule. —C. Portion of the rachis. —D. Spikelet, upper glume view. —E. Spikelet, lower lemma view. —F. Upper anthecium, dorsal view with lateral stigmatic plumule. —G. Upper anthecium, ventral view with lateral stigmatic plumules. —H. Upper palea, lodicules, and gynoecium. (Based on *Irwin et al. 10524.*)

cendent and divergent; main axis up to 3 cm long, flattened, smooth, glabrous, occasionally absent; pulvini glabrous, with a squamiform bract; rachis of the branches flattened, straight, (2–)3–7 cm long, 1–1.6 mm wide, glabrous, the midnerve wavy, pale to greenish, the wings hyaline, nerveless, pale to purplish, the rachis ending in a developed spikelet; pedicels solitary, short, flattened, glabrous; spikelets solitary, imbricate, in 2 series. *Spikelets* long ellipsoid, 4–5 mm long, 1–1.1 mm wide, exclusive of hairs, plano-convex, acute, pilose, silvery; upper glume and lower lemma densely pilose on the lower half, the hairs whitish, otherwise glabrous, smooth, the margins with papillose hairs up to 2.5 mm long, reduced toward the apex. *Lower glume* absent. *Upper glume* as long as the spikelet, membranous, 3-nerved, the nerves thin, one central, the other two marginal, the apex acute, with or without a short tuft of hairs. *Lower lemma* glumiform, as long as the spikelet or slightly shorter, 3- to 5-nerved, the nerves thin. *Lower palea* and *lower flower* absent. *Upper anthecium* long ellipsoid, 3.2–4 mm long, 0.9 mm wide, 0.7–1 mm shorter than the spikelet, plano-convex, cartilaginous; lemma papillate, with small papillae regularly distributed, and a tuft of macrohairs at the apex, the margins flat, not enclosing the upper palea; lodicules 2, ca. 0.3 mm long, conduplicate; stamens 3, the anthers 2 mm long; stigma plumose. *Caryopsis* long obovoid, 2 mm long, 0.9 mm wide; hilum elliptic; embryo 1/3 as long as the caryopsis.

Paratypes. BRAZIL. **Distrito Federal:** Brasília, 975 m, 29 Oct. 1965, *Irwin et al. 9658* (MO, UB); 10 km W of Taguatinga, on road to Braslândia, 1200 m, 25 Nov. 1965, *Irwin et al. 10654* (MO, UB, US); Chapada da Contagem, ca. 20 km NE of Brasília, 1000 m, 28 Oct. 1965, *Irwin et al. 9648* (MO, UB); Brasília, 975 m, 13 Nov. 1965, *Irwin et al. 10257* (MO); Brasília, Lago Azul, Nov. 1988, *Zuloaga 3835* (SI). **Goiás:** ca. 5 km N of jct. rd. W to Pires do Rio by BR-050, ca. 800 m, 7 Dec. 1988, *Kral et al. 75939* (MO); without locality, 1896, *Glaziou 22441* (US, W), *22443* (G, US, W); ca. 14 km S of Corumbá de Goiás, 975 m, 30 Nov. 1965, *Irwin et al. 10737* (MO).

Paspalum goyasense is known from the states of Goiás and Distrito Federal in central Brazil. It occurs in cerrado vegetation between 900 and 1200 msm, in areas where regular fires occur. According to Eiten (1978, 1984), the cerrado is characterized by a clear dry season, between April and September, with nearly 250 mm of rainfall in this period; during the wet season there is an average of 1350 mm. The soils are usually sandy, well drained, and poor in nutrients.

It is likely that this new species also grows in Minas Gerais since it has been collected 25 km east of Cabeceiras, close to the state border between Goiás and Minas Gerais.

Paspalum goyasense also belongs to subgenus *Ceresia* (Chase, ined.), because of its perennial habit, membranous rachis with hyaline wings, spikelets ellipsoid and conspicuously hairy, as well as a cartilaginous upper lemma and palea.

Within *Ceresia*, *P. goyasense* is related to *P. carinatum* Humboldt & Bonpland ex Flüggé. *Paspalum carinatum* differs from *P. goyasense* by filiform (vs. linear) leaves of the former, 0.5–1 mm (vs. 2–4 mm) wide; inflorescences with a single raceme, occasionally 2 (vs. 2, occasionally 1 or 3); rachis of the racemes 1.8–2.5(–3) mm (vs. 1–1.6 mm) wide, arcuate (vs. straight); spikelets with the upper glume densely pilose on the lower third, otherwise scaberulous (vs. pilose in the lower half, otherwise glabrous), with the upper glume and lower lemma flattened (vs. slightly convex) on the upper portion.

Paspalum goyasense is also related to *P. guttatum* Trinius, a member of the *Eriantha* group, which differs by the latter's ligules 0.2 mm (vs. 0.5–0.9 mm) long, with a ciliate pseudoligule (vs. absent); inflorescences with conjugate racemes (vs. racemes alternate), pulvini pilose (vs. glabrous); spikelets ellipsoid (vs. long ellipsoid), with width 1.5–2 mm (vs. 1–1.1 mm); and upper anthecium glabrous and closed at the apex (vs. papillate and gaping).

The specimens *Glaziou 22441* and *22443* were identified, in sched. by Hackel, as *Paspalum obscurum* Nees var. *albescens* Hackel.

Although *Paspalum goyasense* usually has inflorescences with two non-conjugate racemes, the specimens *Glaziou 22441*, *Glaziou 22443*, and *Irwin et al. 9648* have floriferous culms with a single raceme, while three racemes were observed in *Zuloaga 3835*.

KEY TO DIFFERENTIATE *PASPALUM GOYASENSE* FROM RELATED SPECIES OF SUBGENUS *CERESIA*

1. Spikelets solitary, the upper glume with hairs up to 3 mm long, irregularly distributed along the margins, these not corky 2
1′. Spikelets paired, the upper glume uniformly papillose-pilose, with tuberculate hairs 2–7 mm long, the margins corky 5
2(1). Racemes solitary, occasionally 2 then alternate; spikelets 3.3–5 mm long, with long hairs toward the basal margins, otherwise glabrous; upper anthecium 0.6–1.8 mm shorter than the upper glume and lower lemma; adaxial surface of the blade without conspicuous papillae 3
2′. Racemes 2, conjugate, occasionally with a third raceme; spikelets 1.6–3 mm long, the margins densely pilose toward the distal portion, with hairs up to 2 mm long, shortly pilose toward

the base; adaxial surface of the blade conspicuously papillose 4

3(2). Leaf blades linear, 8–20 cm long, 0.2–0.4 cm wide, flat or with involute margins; nodes densely pilose; inflorescences with (1)2(3) racemes; rachis of the racemes 1–1.6 mm wide, straight; spikelets with the lower glume densely pilose in the lower half, otherwise glabrous; upper glume and lower lemma slightly convex . . . . . *P. goyasense*

3′. Leaf blades filiform, 5–20 cm long, 0.5–1 cm wide, folded; nodes glabrous to shortly pilose; inflorescence with 1(2) raceme; rachis of the racemes 1.8–2.5(–3) mm wide, arcuate; spikelets with the lower glume densely pilose in the lower third, otherwise scaberulous; upper glume and lower lemma flattened on the upper portion . . . . . *P. carinatum*

4(2). Spikelets 1.6–2 mm long . . . . . *P. malmeanum* Ekman

4′. Spikelets 2.5–3 mm long . . . . . *P. eucomum* Nees ex Ekman

5(1). Leaf blades lanceolate, 5–21 cm long, 0.5–1.8 cm wide; upper glume with marginal hairs uniformly ciliate and of the same length; lower lemma with glabrous margins 6

5′. Leaf blades linear-lanceolate, 4–13 cm long, 0.1–0.2(–0.5) cm wide; upper glume with short and long hairs on the margins, not uniformly ciliate; lower lemma with the apical margins pilose . . . . . *P. polyphyllum* Nees ex Trinius*

6(5). Inflorescences with 7 to 11 arcuate racemes, the basal ones 6–12 cm long, 0.8–1.2 mm wide; spikelets 0.8–1 mm wide; plants bambusoid, with leaf blades papyraceous, pseudopetiolate . . . . . *P. buchtienii* Hackel

6′. Inflorescences usually with 2 to 6 straight racemes, the basal ones 5–9 cm long, 1.2–1.5 mm wide; spikelets 1.2–1.4 mm wide; plants and leaf blades herbaceous, the blades not pseudopetiolate . . . . . *P. humboldtianum* Flüggé

**Paspalum bicilium* Mez and *P. spissum* Swallen were recently considered synonyms of *P. polyphyllum* and *P. carinatum*, respectively (Zuloaga & Morrone, ined.).

Acknowledgments. We thank Vladimiro Dudás for preparing the excellent illustrations.

Literature Cited

Chase, A. 1929. The North American species of *Paspalum*. Contr. U.S. Natl. Herb. 28: 1–310, i–xvii.

———. Ined. *Paspalum* of South America. Unpublished manuscript. Hitchcock and Chase Library, Botany Department, Smithsonian Institution, Washington, D.C.

Davidse, G. & T. S. Filgueiras. 1993. *Paspalum longiaristatum* (Poaceae: Paniceae), a new serpentine endemic from Goiás, Brazil, and the first awned species in the genus. Novon 3: 129–132.

Eiten, G. 1975. The vegetation of Serra do Roncador. Biotropica 7: 112–135.

———. 1978. Delimitation of the cerrado concept. Vegetatio 36: 169–178.

———. 1984. Vegetation of Brasilia. Phytocoenologia 12: 271–292.

Lleras, E. & J. H. Kirkbride, Jr. 1978. Alguns aspectos da vegetação da serra do Cachimbo. Acta Amazon. 8: 51–65.

Pohl, R. W. 1980. *Paspalum*. *In*: W. Burger (editor), Flora Costaricensis. Fieldiana, Bot. 4: 350–392.

Soembrock, W. G. 1966. Amazon Soils, a Reconnaissance of the Soils of the Brazilian Amazon Region. Centre for Agricultural Publications and Documentation, Wageningen.

Validation of Some Suprageneric Names in Podocarpopsida

Alexander B. Doweld
National Institute of Carpology (Gaertnerian Institution), P.O. Box 72, RUS-119517, Moscow, Russian Federation. nicar@aha.ru

James L. Reveal
Professor Emeritus, University of Maryland, College Park, Maryland 20742-5815, U.S.A.
Mailing address: 18625 Spring Canyon Road, Montrose, Colorado 81401-7906, U.S.A.
jr19@umail.umd.edu

ABSTRACT. Upon learning that the genus *Pherosphaera* W. Archer bis (1850) was a synonym of the monospecific Tasmanian genus *Microcachrys* Hooker f. (1845), the family name Microcachrydaceae Doweld & Reveal (1999) was proposed for conservation giving it priority over Pherosphaeraceae Nakai (1938). The long-used name Pherosphaeraceae was consistently misapplied in the sense of *Microstrobos* J. Garden & L. A. S. Johnson (1951). Accordingly, a new family, Microstrobaceae, is validated and segregated into its own order, Microstrobales. In addition, for those who might wish to recognize the taxon at a lower rank within Podocarpaceae Endlicher, the names Microstroboideae and Microstrobeae are established to replace the already existing but consistently misapplied Pherosphaeroideae Pilger (1903, 1916) and Pherosphaereae Pilger (1903).

Key words: Microcachryaceae, *Microcachrys*, Microstrobaceae, Microstrobales, Microstrobeae, Microstroboideae, *Microstrobos*, *Pherosphaera*, Pherosphaeraceae, Pherosphaereae, Pherosphaeroideae.

In 1999, while validating and proposing several new suprageneric names in Pinophyta Cronquist, Takhtajan & Zimmermann, we proposed Microcachrydaceae Doweld & Reveal for the rare, monospecific Tasmanian genus *Microcachrys* J. D. Hooker (1845). At that time we were not aware that *Pherosphaera* W. Archer bis (1850) was a synonym of *Microcachrys* and that Pherosphaeraceae Nakai (1938) was the correct name for our new family.

The nomenclatural confusion began in 1857 when Joseph Dalton Hooker misapplied Archer's name to plants of a different genus. In this sense, *Pherosphaera* was used until 1951. Aware that the type of *P. hookeriana* W. Archer bis was based on the female reproductive structures of *Microcachrys tetragona* J. D. Hooker, Garden and Johnson proposed *Microstrobos* J. Garden & L. A. S. Johnson. They also published *Microstrobos niphophilus* J. Garden & L. A. S. Johnson as a new species for what had mistakenly been called *P. hookeriana* for nearly a century. When Nakai proposed his family name in 1938, he circumscribed the taxon to include only what is now known as *Microstrobos*.

In 1953, two proposals (Elliott, 1953; Barber, 1953) were published to conserve *Pherosphaera* J. D. Hooker (1857) over *Pherosphaera* W. Archer bis (1850). Later, Florin (1956), aware of the typification problem, placed *Microstrobos* in synonymy under *Pherosphaera* J. D. Hooker and proposed *Pherosphaera niphophila* (Garden & L. A. S. Johnson) Florin (Shinners, 1957). In 1958, the Committee for Spermatophyta rejected conservation of the later homonym and proclaimed *Microstrobos* to be the correct name for what had long been known as *Pherosphaera* (Rickett, 1958). Even so, *Pherosphaera* sensu J. D. Hooker continued to be used (e.g., Gaussen, 1974; Willis, 1973; Wielgorskaya, 1995; Melikyan & Bobrov, 2000).

Reveal and Doweld (2001) have proposed conservation of Microcachrydaceae so that the correct family name for the only genus in the taxon, *Microcachrys*, would be Microcachrydaceae rather than Pherosphaeraceae. Nonetheless, we recognize the necessity of establishing a family for *Microstrobos*, and thus propose Microstrobaceae. It is noteworthy that recently Melikyan and Bobrov (2000) used Pherosphaeraceae for this taxon, being unaware, like us, that *Pherosphaera* was a synonym of *Microcachrys* (which they placed in Microcachrydaceae). In addition, these authors proposed a new order "Microstrobales" Bobrov & Melikyan; however, Article 16.1 of the *Code* (Greuter et al., 2000) requires that all typified ordinal names be based on a validly published family name.

By establishing Microstrobaceae and validating Microstrobales following the classification scheme

proposed by Melikyan and Bobrov (2000), we hope to remove all references to the long-confused use of the generic name *Pherosphaera* for *Microstrobos*. However, we are fully aware that others consider *Microstrobos* to be a taxon within Podocarpaceae Endlicher (Conran et al., 2000; Hart, 1987; Kelch, 1997, 1998), and therefore validate both Microstroboideae and Microstrobeae. We knowingly—as permitted by the last sentence in Article 34.1 of the *Code* (Greuter et al., 2000)—take this action firstly to correct the misapplication of *Pherosphaera* for *Microstrobos* at the ranks of subfamily and tribe as suggested by Pilger (1903, 1916), and secondly to provide the necessary nomenclature in Podocarpaceae or whatever other family one might wish to use for these taxa.

It is essential to emphasize that judging by the original Pilger (1903) and Nakai (1938) descriptions, the names Pherosphaeraceae, Pherosphaeroideae, and Pherosphaereae were established for plants recognized now as belonging to the genus *Microstrobos* (= *Pherosphaera* J. D. Hooker, 1857, non W. Archer bis, 1850). We hope that Microcachrydaceae will be conserved over Pherosphaeraceae but acknowledge that these changes will cause some confusion for researchers consulting the older literature. By correcting the names according to the *Code* (conservation of *Pherosphaera* Hooker f. over W. Archer bis was rejected in 1958!), we hope our modifications will promote nomenclatural stability in the future.

Microstrobaceae Doweld & Reveal, fam. nov. TYPE: *Microstrobos* J. Garden & L. A. S. Johnson, Contr. New S. Wales Nat. Herb. 1: 316. 1951.

Arbores sempervirentes, dioicae; folia acicularia, imbricata, in 4–5 lineas (nunquam decussata vel opposita) disposita; strobili masculi sessiles solitarii, grana pollinis 3-saccata; strobili feminei solitarii sessiles, ovoidei, in aggregationes 2–8, bracteae imbricatae, acuminatae; semen unicum, epimatium nullum.

Evergreen dioecious shrubs; leaves scale-like, imbricate, arranged in 4–5 rows but never decussate or opposite; male cones sessile, solitary, pollen with 3 air sacs; female cones solitary, sessile, ovoid, in aggregations of 2–8, bracts imbricate, acuminate; seed 1, epimatium lacking.

Microstrobales Melikyan & Bobrov ex Doweld & Reveal, ord. nov. TYPE: *Microstrobos* J. Garden & L. A. S. Johnson, Contr. New S. Wales Nat. Herb. 1: 316. 1951. Microstrobaceae Doweld & Reveal, Novon 11: 396. 2001.

Ab ordinibus Podocarpalibus Saxegothaealibusque epimatiis nullis differt.

An order differing from the Podocarpales and the Saxegothaeales in lacking an epimatium.

Microstroboideae Doweld & Reveal, subfam. nov. TYPE: *Microstrobos* J. Garden & L. A. S. Johnson, Contr. New S. Wales Nat. Herb. 1: 316. 1951. Microstrobaceae Doweld & Reveal, Novon 11: 396. 2001.

Arbores sempervirentes, dioicae; strobili masculi sessiles solitarii, terminales; strobili feminei terminales, solitarii sessiles, bracteae imbricatae, acuminatae; semen erectum, unicum, epimatium nullum.

Evergreen dioecious shrubs; male cones sessile, solitary, terminal; female cones terminal, solitary, sessile, bracts imbricate, acuminate; seed erect, one, epimatium lacking.

Microstrobeae Doweld & Reveal, trib. nov. TYPE: *Microstrobos* J. Garden & L. A. S. Johnson, Contr. New S. Wales Nat. Herb. 1: 316. 1951. Microstrobaceae Doweld & Reveal, Novon 11: 396. 2001.

Arbores sempervirentes, dioicae; folia acicularia, imbricata, in 4–5 lineas (nunquam decussata vel opposita) disposita; strobili terminales, sessiles, solitarii; semen unicum, erectum, epimatium nullum; numerus chromosomatum haploideus $n = 13$.

Evergreen dioecious shrubs; leaves scale-like, imbricate, arranged in 4–5 rows but never decussate or opposite; cones terminal, sessile, solitary; seed one, erect, epimatium lacking; $n = 13$.

Acknowledgments. We are grateful to K. N. Gandhi at Harvard University Herbaria who provided us with some of the literature for this paper, and to a reviewer who provided additional clarifications and suggestions. This research is a contribution to the Systema Spermatophytorum Project of the National Institute of Carpology (Gaertnerian Institution), Moscow. This study is part of the Index Nominum Supragenericorum Plantarum Project from the Norton-Brown Herbarium (MARY) and presented with the cooperation of the International Association for Plant Taxonomy and the National Agricultural Library, Beltsville, Maryland.

Literature Cited

Archer, W. 1850. Note on *Microcachrys*, Hook. fil., and on a new allied genus of Coniferae of Van Diemen's Land. Hooker's J. Bot. Kew Gard. Misc. 2: 51–52.

Barber, H. N. 1953. Propositions pour le Congrès de Paris, nos. 28–32. Taxon 2: 214.

Conran, J. G., G. G. Wood, P. G. Martin, J. M. Dowd, C.

J. Quinn, P. A. Gadek & R. A. Price. 2000. Generic relationships within and between the gymnosperm families Podocarpaceae and Phyllocladaceae based on an analysis of the chloroplast gene *rbc*L. Austral. J. Bot. 45: 715–724.

Doweld, A. B. & J. L. Reveal. 1999. Validation of new suprageneric names in Pinophyta. Phytologia 84: 363–367.

Elliott, C. G. 1953. Proposal no. 32. Proposal to conserve the genus *Pherosphaera* sensu Hooker. Taxon 2: 141.

Florin, R. 1956. Nomenclatural notes on genera of living gymnosperms. Taxon 5: 188–192.

Garden, J. & L. A. S. Johnson. 1951. *Microstrobos*, a new name for a podocarpaceous genus Contr. New S. Wales Nat. Herb. 1: 315–316.

Gaussen, H. 1974. Les Gymnosperms actuelles et fossiles. Fascicule XIII. Les Podocarpines sauf les *Podocarpus*. Trav. Lab. Forest. Toulouse 2(1) fasc. XIII: 1–174.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth. 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Hart, J. A. 1987. A cladistic analysis of conifers: Preliminary results. J. Arnold Arbor. 68: 269–307.

Hooker, J. D. 1845. On the Huon Pine, and on *Microcachrys*, a new genus of Coniferae from Tasmania; together with remarks upon the geographical distribution of that order in the Southern Hemisphere. London J. Bot. 4: 137–157.

———. 1857. Coniferae. Bot. Antarct. Voy. 3 [Fl. Tasman.]: 349–359.

Kelch, D. G. 1997. The phylogeny of the Podocarpaceae based on morphological evidence. Syst. Bot. 22: 113–131.

———. 1998. Phylogeny of Podocarpaceae: Comparison of evidence from morphology and 18S rDNA. Amer. J. Bot. 85: 986–996.

Melikyan, A. P. & A. V. Bobrov. 2000. Morphology of female reproductive structures and an attempt of the construction of phylogenetic system of orders Podocarpales, Cephalotaxales, and Taxales. Bot. Zhurn. (Moscow & Leningrad) 85(7): 50–67.

Nakai, T. 1938. Indigenous species of conifers and taxads of Korea and Manchuria, and their distribution. Tyosen-Sanrin 158: 1–15.

Pilger, R. 1903. Taxaceae. Pflanzenr. IV, 5(Heft 18): 1–124.

———. 1916. Kritische Übersicht über die neuere Literatur betreffend die Familie der Taxaceae. Bot. Jahrb. Syst. 54: 1–43.

Reveal, J. L. & A. B. Doweld. 2001. A proposal to conserve the family name Microcachrydaceae (Pinophyta). Taxon 50.

Rickett, H. W. 1958. Report of the Committee for Spermatophyta. Conservation of generic names I. Taxon 7: 184–193 [Pherosphaera: 186].

Shinners, L. H. 1957. Against conservation of *Xanthophyllum* and *Pherosphaera*. Taxon 6: 135–137.

Wielgorskaya, T. 1995. Dictionary of Generic Names of Seed Plants. Columbia Univ. Press, New York.

Willis, J. C. 1973. A Dictionary of the Flowering Plants and Ferns, revised by H. K. Airy Shaw, 8th ed. Cambridge Univ. Press, Cambridge.

New or Misunderstood Species of *Commelina* (Commelinaceae) from the *Flora of Tropical East Africa* and *Flora Zambesiaca* Areas

Robert B. Faden

Department of Systematic Biology–Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0166, U.S.A.

ABSTRACT. *Commelina disperma* Faden is described from Tanzania and is separated from *C. zenkeri* and *C. macrosperma* by its seeds. *Commelina kituloensis* Faden is described from the southern highlands of Tanzania and the Nyika Plateau of Malawi and Zambia and is distinguished from *C. hockii* by spathe, floral, capsular, and seed characters. *Commelina zenkeri* C. B. Clarke is found to be the correct name for a Ugandan species that was thought to be undescribed.

Key words: Africa, *Commelina,* Commelinaceae, Tanzania, Uganda, Zambia.

With about 100 species, *Commelina* L. is the largest genus of Commelinaceae in Africa. At least 65 species occur in the combined areas of the *Flora of Tropical East Africa* (Kenya, Uganda, and Tanzania) and *Flora Zambesiaca* (Malawi, Mozambique, Zambia, Zimbabwe, and Botswana), for which I am writing family treatments. Previously, I have recognized and described a number of new taxa of *Commelina* from these floristic areas (Faden, 1994; Faden & Alford, 2001). Two further new species of the genus from this region are now well characterized and are described below. A third species, from Uganda, initially thought to be new, has proven to be an apparently rare species from Cameroon. It is described and illustrated because of its apparent disjunct distribution and because it has been misunderstood.

Commelina disperma Faden, sp. nov. TYPE: Tanzania (T4). Kigoma Dist.: Livandabe Mountain, 5°58′S, 30°02′E, alt. 1100–1200 m, tall closed forest with *Pterygota, Newtonia, Blighia, Lecaniodiscus, Pseudospondias, Sterculia, Parkia, Ficalhoa,* 28 May 1997, *S. Bidgood, D. Sitoni, K. Vollesen & C. Whitehouse 4153* (holotype, K; isotype, US 3375780). Figure 1.

Herba perennis; radices crassae non tuberosae; spathae solitariae vel usque ad tres laxe aggregatae, bracteatae, 12–15 mm longae, 8–9 mm altae, marginibus basi 3–4 mm connatis; flores pallide azurei; capsulae biloculares, bivalves, 4 × 5.2 mm, biseminales; semina ellipsoidea, 3.2–3.4 × 2.5–2.6 mm, testa brunnea reticulato aurantiaco.

Perennial herb from a short-creeping rootstock; roots thick, fleshy but not tuberous, dark brown, covered by persistent root hairs; shoots 1 or 2 per plant, erect to ascending, unusually unbranched, not rooting at the nodes, to 60 cm long; internodes to 11.5 cm long, with a line of hook-hairs, at least distally, continuous with the fused edge of the distal sheath. Leaves distichous, sheaths 1–2.3 cm long, ± auriculate at the summit, puberulous with hook-hairs, ciliolate at the summit; lamina petiolate (at least in the distal leaves), lanceolate-elliptic (to ovate-elliptic), 5–11 × 2–3 cm, apex acuminate to attenuate, base strongly oblique, one side rounded, the other side cuneate, margins scabrous, also ciliate basally, adaxial surface scabrous with scattered prickle-hairs, abaxial surface shortly hirsute with uniseriate hairs and a smaller number of hook-hairs. Spathes terminal, solitary or up to 3 loosely clustered per shoot, bracteate; peduncles 6–10 mm long, puberulous with a line of hook-hairs; spathes 12–15 mm long, 8–9 mm high, not falcate, apex acute to obtuse, mucronate, base truncate to hastate, margins fused for 3–4 mm, puberulous along the fused portion with hook-hairs and uniseriate hairs, otherwise glabrous, surfaces glabrous, green but whitish basally; upper cincinnus lacking or vestigial and included in the spathe, lower cincinnus 2(to 4)-flowered, its peduncle 7–10 mm long, glabrous, bracteoles present. Flowers bisexual, very pale blue; pedicels 3–5 mm long; upper sepal hooded, 2.6–3 mm long, lateral sepals ovate-elliptic to obovate-elliptic, completely fused in bud, fused less than half their length in flower, ca. 3.2 × 2.5 mm; paired petals held erect, pale blue, claws ca. 3.5 mm long, lower petal linear-lanceolate, 2–2.5 × 0.5 mm; staminodes 3, filaments ca. 3.5 mm long, antherodes ca. 0.5–0.75 mm diam., yellow, cruciform or irregular; lateral stamens with filaments ca. 6.5–7 mm long, anthers oblong, 1–1.5 mm long; medial stamen with filament 5–5.5 mm

Figure 1. *Commelina disperma* Faden. —A. Habit. —B. Spathe, lateral view. —C. Perfect flower, front/lateral view. —D. Capsule, dorsal view. —E. Seed, dorsal view. —F. Seed, ventral view. All from *Bidgood, Sitoni, Vollesen & Whitehouse 4153* (K), except C, which was drawn from a slide of the plant taken in the field by Kaj Vollesen. Illustration by A. R. Tangerini.

long, anther saddle-shaped, strongly curved, ca. 1.5–2 mm long, yellow; ovary ca. 1.5 mm long, style ca. 7–8 mm long, stigma capitate. Capsules bilocular, bivalved, broadly elliptic to obovate in outline, 4 × 5.2 mm, olive, apex truncate, locules 1-seeded. Seeds ellipsoid, not compressed, 3.2–3.4 × 2.5–2.6 mm, testa dark brown, with a low, raised, dull orange reticulum forming radially elongate cells on the dorsal surface, with transverse walls sometimes interrupted, densely white farinose within the reticulum; hilum slightly raised, straight.

Habitat. Tall closed forest with *Pterygota, Newtonia, Blighia, Lecaniodiscus, Pseudospondias, Sterculia, Parkia, Ficalhoa*; 1100–1200 m.

Flowering. Flowering and fruiting in May.

Chromosome number. Unknown.

Distribution. Western Tanzania (T4); known only from the type.

The flower was drawn from a slide of a plant taken by one of the collectors (Kaj Vollesen). It was not a close-up, so the size of the flower is approximate, and some details may not be fully accurate. However, the ascending petals facing each other were clearly observable. If this character should prove consistent, it would be distinctive of the species.

Among East African species *Commelina disperma* is most similar to *C. zenkeri* from Uganda. The two species have in common: a similar habit with more or less tufted, ascending, typically unbranched shoots with distichous, petiolate leaves with a very oblique base; spathes shortly pedunculate, sometimes or regularly bracteate, solitary or two to three in loose clusters at the ends of the shoots; paired sepals at least partially fused; medial petal very small; and capsule two-seeded. This species differs from *C. zenkeri* by its thick roots, upper cincinnus lacking or vestigial (vs. upper cincinnus often developed and producing a male flower), sepals fused less than half their length (vs. more highly fused), and seeds with a low, raised, dull orange reticulum on the dorsal surface (vs. seeds uniformly brown, smooth).

If seed features are significant, then *C. disperma* may be most closely related to *C. macrosperma* from Sierra Leone, Ghana, and Nigeria, which also has a two-seeded capsule and seeds with a raised orange reticulum. The latter species differs by lacking thick roots, by having smaller flowers (e.g., paired petals ca. 6 × 4 mm), the paired petals always pure white (vs. pale blue), the medial petal broad, the capsules larger (ca. 6 × 6 mm vs. 4 × 5.2 mm), and the seeds longer and proportionally narrower (4.5 × 2.3–2.5 mm vs. 3.2–3.4 × 2.5–2.6 mm). The testa pattern in *C. macrosperma* differs from *C. disperma* in being foveolate-reticulate (vs. reticulate), the reticulum walls of the former thicker, smoother, higher and not tending to be radially elongate or having occasional transverse walls interrupted, the depressions between the walls smaller, not radially elongate and more polygonal than rectangular.

Commelina macrosperma has the highly unusual chromosome number of $2n = 22$ (also reported as $2n = 20$ by Morton, 1956, 1967; see Faden & Suda, 1980, for discussion), which otherwise occurs only in *C. benghalensis* L. No living material of *C. disperma* has been obtained, so its chromosome number is unknown.

According to one of the collectors (Vollesen, pers. comm.) the type locality, near Lake Tanganyika, is very inaccessible and has yielded other interesting species. It is unclear how floristically distinct this forest patch might be from other forests near or along the lake. They would be the obvious habitats to search for further populations of *C. disperma.*

Commelina kituloensis Faden, sp. nov. TYPE: Tanzania (T7). Njombe Dist. [Makete Dist. on label]: Kitulo Plateau, 36 km E of turnoff on Mbeya–Tukuyu road, 9°04′52″S, 33°51′27″E, alt. 2880 m, new potato field and adjacent montane grassland, 27 June 1996, *R. B. Faden, S. M. Phillips, A. M. Muasya & E. Macha 96/438* (holotype, US 335706; isotypes, BR, EA, NHT, K, MO, PRE, US 335708). Figure 2.

Herba perennis; radices bases 2–3 mm crassae, albidae; spathae solitariae, 1.7–4.5(–5.3) cm longae, 0.6–1.8 cm altae, marginibus haud connatis, plerumque ciliatis, pagina dense vel sparsim hirsuta, pedunculo spathae (2.5–) 3–10(–15) cm longo; cincinnus superior plerumque florem unicum masculinum efferens; flos sepalis lateralibus per 2/3–7/8 longitudinum connatis, limbo petalorum binatorum valde undulato, petalo inferiore plano a petalis binatis discolori; capsulae triloculares, bivalves usque ad 5-seminales; semina loculis ventralibus testa foveato-reticulato.

Perennial; roots numerous, 2–3 mm thick at the base but not tuberous, whitish; shoots annual, tufted, arising from a subterranean base, unbranched or sparsely branched, (10–)15–40(–45) cm tall, erect to ascending or sometimes recumbent at the base, rarely rooting; internodes to 17 cm long, glabrous or glabrescent to densely white puberulous or finely hirsute. Leaves spirally arranged or distichous, sheaths sometimes clustered at the base of the shoots, spaced at least medially, 1–3(–3.5) cm long, with a line of either fine or long hairs along

the fused edge, otherwise the surface glabrous to puberulous or hirsute, ciliate at the apex, lamina sessile, planar or conduplicate, oblong-lanceolate to linear-lanceolate or, rarely, linear or ovate-elliptic, 4–12(–16) × (0.3–)0.5–2(–2.5) cm, apex acuminate to acute, base cuneate to rounded, margins ciliate or glabrous, not scabrous, surfaces densely hirsute to glabrous. Spathes arising distally on the shoots, solitary, peduncles (2.5–)3–10(–15) cm long, usually densely hirsute, rarely the pubescence reduced to a single, longitudinal band; spathes 1.7–4.5(–5.3) cm long, 0.6–1.8 cm high, filled with liquid when fresh, usually not at all to very slightly falcate (rarely strongly falcate), the folded edge often somewhat saccate basally, apex acute to acuminate, rarely attenuate, base cordate to hastate, margins free, usually ciliate, occasionally glabrous, surface densely to sparsely hirsute, the veins broadly striped and/or the whole spathe flushed with red or reddish purple (rarely entirely green); upper cincinnus with peduncle 8–16(–24) mm long, short- or long-exserted from the spathe, usually glabrous, occasionally pubescent, usually producing 1 male flower, occasionally the flower bisexual or the cincinnus more than 1-flowered, lower cincinnus with peduncle 7–13 mm long, 5- to 12-flowered, included, glabrous. Flowers bisexual and male, 25–30 mm wide; upper sepal ovate to ovate-elliptic, or rarely lanceolate, 4–6.5(–7) × 2.6–3.2 mm, reddish purple with green veins, glabrous; lateral sepals fused for 2/3–7/8 their length, forming a broad, shallow cup, each sepal broadly elliptic to ovate-elliptic, 5–8 × 3.8–4.8 mm, reddish purple except green on the side where they meet or half reddish purple and half green, glabrous; paired petals pale blue, lavender or purple to nearly white (RHS colors 92D, 97B in *Faden et al. 96/438*, type), 12–18 × 11–14 mm, limb suborbicular to broadly ovate-reniform, strongly undulate, 9–12 × 11–14 mm, apex rounded, base cordate, margins crenate, claw 4–6 mm long, reddish purple; lower petal strongly reflexed to not reflexed, ± planar, with apex not recurved, ovate, 5.3–9 × 3.3–4.3 mm, white or cream; staminodes 3, ± equal, filaments 3–7 mm long, reddish purple, antherodes 6-lobed, 1.5–2.4 × 1.5–1.8 mm, yellow, the small polliniferous lobes sometimes with faint darker markings; lateral stamens with filaments divergent, arcuate-decurved, 6–11 mm long, flesh pink (to nearly white), anthers lanceolate-elliptic to elliptic, 1.6–3 × 0.75–1.3 mm, connective gray-green, pollen sacs blue-black (anthers oblong and entirely dark when dried), dehiscence extrorse, pollen creamy yellow; medial stamen with filament recurved so that the anther is held among the antherodes, filament 4–7 mm long, flesh pink at base, reddish purple distally, anther saddle-shaped, 2.2–3.5 × 1.7–2.1 mm, yellow with a broad, transverse, nearly black patch to almost entirely blue-black, with prominent, sterile, yellow basal lobes, pollen orange-yellow; ovary ovoid-ellipsoid, ca. 1.3–1.7 × 0.9 mm, green, style greatly exceeding the stamens and held above them, 7–16 mm long, arcuate decurved, then recurved at the apex, reddish purple, shading to blue-purple at the apex, stigma small, blue-purple. Capsules trilocular, bivalved, up to 5-seeded, partly covered by the large, marcescent upper sepal, oblong-elliptic, (4–)5–6 × 2.4–3 mm, weakly or strongly beaked, when immature green with a reddish apex, when mature medium brown, or sometimes the ventral valve flushed with reddish purple, dorsal valve ± deciduous, dorsal locule 1-seeded or empty, indehiscent, ventral locules (none to)2-seeded, dehiscent. Dorsal locule seed attached to the capsule wall, strongly dorsiventrally compressed, elliptic in outline, ca. 2.5 × 1.7 mm, testa brown, ± alveolate, with or without a longitudinal, mid dorsal ridge, hilum straight, slightly raised. Ventral locule seeds dorsiventrally compressed, ovate or deltate to transversely elliptic in outline, (1.45–)1.65–2.6 mm × (1.5–)1.7–1.8 mm, testa dark brown or gray-brown, foveate-reticulate, sometimes the depressions radially elongate, with prominent, narrow, radial ridges between them or the testa essentially radially ridged, ridges and higher spots rugose with white or ± concolorous bead-like particles, these usually in a single row, but occasionally in multiple rows and ± obscuring the depressions, giving the entire surface a granular appearance, the depressions sometimes with slightly paler particles, farinose granules lacking, embryotega concolorous or contrasting with testa, with a short or moderately long, blunt apicule, hilum dark brown, short, straight, flush with the surface or slightly raised.

Habitat. Montane grassland, sometimes in rocky areas, at roadsides or near streams, rarely in stunted *Brachystegia* woodland; (1600–)1830–2880 m in altitude.

Flowering. Flowering October through June, but mainly December to February; flowers were found open between 1400 and 1500 hr. on a cold, overcast day, so the typical flowering time is unknown

Chromosome number. $n = 30$ (Lewis, 1964: 283, as "*Commelina* sp. 10").

Distribution. Southern highlands of Tanzania (T7) and the Nyika Plateau of northern Malawi and northeastern Zambia.

Figure 2. *Commelina kituloensis* Faden. —A. Habit. —B. Spathe, lateral view. —C. Perfect flower, front/lateral view. —D. Paired petal, showing shape and venation. —E. Medial stamen, anther, and part of filament, dorsal view. —F. Antherode and part of filament, ± front view. —G. Immature capsule, with sepals removed, lateral view. —H. Immature

The species that is described here as *C. kituloensis* was recognized and labeled "*Commelina* sp. 'C' aff. *purpurea*" by Brenan in the Kew Herbarium. However, *C. purpurea* C. B. Clarke has trivalved (instead of bivalved) capsules and orange to orange-brown (instead of lavender) flowers, which indicates that the relationships of *C. kituloensis* are elsewhere. I believe that the new species is most closely related to *Commelina hockii* De Wildeman of southern Tanzania, Zambia, Congo (Kinshasa), and possibly Angola because of its capsule type, in combination with its tufted perennial habit, large spathes with free margins, apparent abundant liquid in the spathes, and numerous buds in the lower cincinnus. It differs from *C. hockii* by its more numerous, thinner, whitish (vs. dark) roots, usually densely pubescent foliage and spathes, shorter (1.7–4.5(–5.3) cm long vs. 3–9(–11) cm long), proportionally broader spathes usually with a much less attenuate apex, usually a solitary flower in the upper cincinnus (vs. upper cincinnus typically 7- to 14-flowered), the upper cincinnus peduncle usually shorter (8–16(–24) mm long vs. (13–)16–33 mm long), lower sepals fused 2/3–7/8 (vs. up to 1/4) of their length; paired petals usually lavender to purple (although often described as "blue" by collectors) (vs. paired petals usually white or occasionally pink), lower petal more or less planar, ovate, contrastingly colored with the paired petals, apex not recurved (vs. lower petal shallowly boat-shaped, elliptic to oblong-elliptic or ovate-elliptic, concolorous with the paired petals, apex recurved), and smaller capsules (4–6 mm long vs. 8–9 mm long) and seeds (mostly 1.65–2.6 × 1.7–1.8 mm vs. 2.5–3.5 × 1.9–2 mm). In addition, *C. kituloensis* occurs at generally higher elevations than *C. hockii* ((1600–)1830–2880 m vs. (1250?–)1650–1980 m).

Commelina kituloensis has a number of unusual features. Fresh spathes are full of liquid, which is apparently rare for a species whose spathes do not have fused margins. The strongly undulate petals are much more three-dimensional than in typical *Commelina* flowers. The large, flat, contrastingly colored lower petal is also distinctive. The high degree of fusion in the lateral sepals is very unusual when the lower petal is so large and conspicuous. Although most collectors have termed the flowers blue, they are not the typical sky blue of species such as *C. benghalensis* L. or *C. erecta* L., but rather—at least in the type collection—a blue mixed with violet.

Two of the Malawian collections (*Phillips 746* and *Benson 394*) and the single Zambian collection (*Simon et al. 1638*) seen are atypical. *Simon et al. 1638* has the narrowest leaves (minimum 3 mm wide) of any examined specimen of *C. kituloensis*, and *Phillips 746* and *Benson 394* show a tendency to produce a multiflowered upper cincinnus, with these present in at least three of the nine spathes on the former collection and two of the four spathes on the latter. In two of the spathes of *Phillips 746* the upper cyme has at least seven buds, whereas in *Benson 394* the two upper, multiflowered cymes appear to have five and three buds respectively. Not more than three buds have been seen on either of the Tanzanian collections that show an occasional multiflowered upper cincinnus (*Stolz 2354*, from an unusual spathe, and *Clair-Thompson 870*).

The most atypical specimen that I have included in *C. kituloensis* is *Richards 18563*. The specimen has the longest, most falcate spathes, with among the most attenuate apices seen in this species. The spathes also seem to be entirely green, which is unusual in *C. kituloensis*. Were it not for the plant's dense pubescence, flowers described as "blue," and occurrence at high elevation (2100 m) it would be a much better match for *C. hockii* than for the new species.

Several specimens from lower elevations that bear some resemblance to *C. kituloensis* have been excluded. *Richards 17286* (K), *Lewis 6185* (K), and *Lewis 6226* (K, US), all from Mwinilunga District, Zambia, between 1130 and 1280 m elevation, differ from *C. kituloensis* by having thick roots, spathes glabrous except for ciliate margins, and a many-flowered upper cincinnus. They may represent an undescribed species. It is noteworthy that Lewis (1964) reported the meiotic count of $n = 30$ for *Lewis 6185* and *6226* (his "Species 9"), the same count as he reported for *Lewis 6085* (his "Species 10"), which is *C. kituloensis*.

Richards 13833 (K), from Mbeya District, Tan-

←

capsule, with sepals removed, dorsal view. —I. Mature capsule, lateral view, the upper sepal (left) completely covering the dorsal capsule valve, the paired sepals (right) shriveled, revealing the ventral capsule valve. —J. Dorsal locule seed, dorsal view. —K. Dorsal locule seed, ventral view. —L. Ventral locule seed, dorsal view. —M. Ventral locule seed, ventral view. A is from *Faden, Phillips, Muasya & Macha 96/438* (US sheet 3350706), a field photograph of the same plant, and a photograph of the root system of a field-collected plant; B, D–G are from FAA-preserved, field-collected material of *Faden, Phillips, Muasya & Macha 96/438*; C is from a close-up slide of *Faden, Phillips, Muasya & Macha 96/438*, taken in the field by the author; and I–M are from *Faden, Phillips, Muasya & Macha 96/421*. Illustration by A. R. Tangerini.

zania, was growing in woodland at 1400 m. It differs from *C. kituloensis* in the leaves scabrous above, but otherwise glabrous, with margins scabrous apically, and spathes scabrous or finely hirsute only basally, with margins sparsely ciliate only basally. The flowers were described as blue and small by the collector. It is possible that this specimen represents a lower elevation form of *C. kituloensis*, but unless and until it can be connected to the higher elevation collections by either intermediate forms or congruent, distinctive reproductive features, it is best excluded from the species.

Lovett 1288, which comes from the second lowest elevation (1830 m) recorded for *C. kituloensis*, is also recorded from *Brachystegia* woodland. When we visited the locality, Lake Ngowasi Dam, in 1996, the habitat seemed quite wrong for the species. However, this was after the rainy season had ended, so not finding the plant was hardly proof of its absence. Clearly, these lower elevational plants need further collection and study.

One of the most unusual features of *C. kituloensis*, and perhaps the most important reason why it has remained unnamed for so long, despite the numerous collections, is the apparent scarcity of seed production. Only a single specimen at Kew was found to have ripe seeds. In the field, albeit when only old plants were available, intensive searching produced few mature seeds. From the shape of the capsules collected one could conclude that rarely do all five seeds develop and mature. Whether this is due to lack of pollination, post-pollination incompatibility, the cold weather, or perhaps some combination of factors is unknown.

The type collection of *C. kituloensis* was made in late June, a time of year when this species would not ordinarily have been flowering, yet the plants were in full flower. Just 4 km down the road another population was found (*Faden et al. 96/421*) in which the shoots of all specimens were completely dry. The significant difference was the habitat. The dried plants were growing in undisturbed grassland. The flowering plants at the type locality, however, were for the most part growing in a recently planted potato field. It is possible that either the cultivation of the ground per se and/or the addition of fertilizer, pesticide, or herbicide stimulated the dormant plants of *C. kituloensis* to resume growth, providing us with a serendipitous opportunity to see, record, and collect the plants in flower. The cold weather and overcast skies probably were responsible for our finding the flowers open in mid afternoon.

Paratypes. MALAWI. **Rumpi Distr.:** Nyika Plateau, 7 km from Kasaramba View Point on road to Chelinda Camp, 2480 m, 14 May 1970, *Brummitt 10715* (SRGH); Nyika Plateau, Kasalamba, [= Kasaramba] 7500 ft. [2285 m], 24 May 1967, *Chimphamba 52* (SRGH); Nyika Plateau, Kasaramba road, 8000 ft. [2440 m], 8 Jan. 1974, *Pawek 7871* (K); Nyika Plateau, 7500 ft. [2285 m], 6 Dec. 1975, *Phillips 507* (SRGH, mixed collection with *C. neurophylla*); Nyika Plateau, 7600 ft. [2315 m], 27 Dec. 1975, *Phillips 746* (K); Nyika Plateau, L. Kaulime, 2190 m, 18 Feb. 1961, *Mrs. Richards 14382* (K); Nyika Plateau, near Zambia Rest House, ca. 7000 ft. [2135 m], 5 Feb. 1968, *Simon, Williamson & Ball 1638* (K); Nyika Plateau, Chelinda-Zambia Rest House road, near rest house, 10°33′S, 33°43′E, 11 Dec. 1981, *Van der Linden 278* (BR). TANZANIA. T7. **Iringa Distr.:** Lake Ngwazi [= Ngowasi] Dam end, 8°30′S, 35°15′E, 1830 m, 1 Jan. 1987, *Lovett 1288* (K, US); Irundi Hill, 8°30′S, 35°15′E, 2000 m, 6 May 1987, *Lovett, Lovett, Keeley & de Lyser 2086* (US). **Mbeya Distr.:** Luleza, Mbeya, 1850 m, 9 Feb. 1975, *Aleyung 246* (K); Mbeya Range, ca. 8 mi. [12.9 km] NE of Mbeya, 7200 ft. [2195 m], 24 Oct. 1962, *Lewis 6085* (K, US); Mbeya Mt., NE of peak, 2500 m, 15 May 1956, *Milne-Redhead & Taylor 10206* (K); Mbeya Peak Forest Reserve, ca. 8000 ft. [2440 m], 14 Nov. 1958, *Myembe 98* (K); Mbeya Mt., 2100 m, 13 Dec. 1962, *Mrs. Richards 17037* (K, SRGH); Chimala Escarpment, above Kitakalo [= Kitakala] Mission, 2100 m, 5 Dec. 1983, *Mrs. Richards 18563* (K); S slopes of Poroto Mts., 3 Mar. 1932, [collector's name illegible] *706* (K). **Njombe Distr.:** [Makete Distr. on label], Kitulo Plateau, 32 km E of the turnoff on Mbeya–Tukuyu road, 9°03′27″S, 33°50′23″E, 2850 m, *Faden, Phillips, Muasya & Macha 96/421* (EA, K, NHT, US); Kikondo Village, 2300+ m, 15 Nov. 1982, *Leliyo 321* (K), 25 Apr. 1983, *Leliyo 409* (K); Kitulo Plateau, 2400 m, 5 Jan. 1957, *Mrs. Richards 7465* (K). **Njombe/Mbeya Distr.:** Kitulo Sheep Station, 9000 ft. [2745 m], 7 Feb. 1970, *Fuller 46* (K); Kitulo (Elton) Plateau, banks of small tributary of Ndumbi River just E of bridge on Matamba–Kitulo road, 9°03′S, 33°55′E, 2560 m, *Gereau, Lovett & Mtweve 3181* (US); Kitulo Plateau, 9°00′S, 33°50′E, 2800 m, 12 Dec. 1989, *Lovett, Sidwell & Kayombo 3666* (US); Elton Plateau, 2100 m, 25 Jan. 1961, *Mrs. Richards 14180* (K); Kitulo Plateau, 9°05′S, 33°58′E, 2400 m, 1 Mar. 1991, *Suleiman & Fundi 22* (US). **Rungwe Distr.:** Upper Kiwarar [= Kiwira] Fishing Camp between Poroto & Rungwe Mts., 6600–7000 ft. [2010–2135 m], 29 Nov. 1958, *Napper 1189* (K, SRGH); Kiwira Forestry Station, 2400 m, 9 Feb. 1961, *Mrs. Richards 14332* (K); Rungwe Mt., upper fishing camp, Kawara [= Kiwira] River, 2250 m, 9 Dec. 1963, *Mrs. Richards 18628* (K); Kyimbila, 8 Dec. 1913, *Stolz 2354* (BR, K). **District Uncertain:** Mbou(?), Jassal, 5500 ft. [1675 m], 14 Nov. 1932, *Davies 672* (K). **Locality Unknown:** 11 Mar. 1932, *Clair-Thompson 870* (K). ZAMBIA. **District Unknown:** Nyika Plateau, ca. 2 mi. [3.2 km] from Government Rest House, 7000 ft. [2135 m], 1 Jan. 1964, *Benson NR394* (K).

Commelina zenkeri C. B. Clarke, in Thiselton-Dyer, Flora of Tropical Africa 8: 59. 1901. TYPE: Cameroon: Yaoundé-Station, alt. 800 m, 1890–1894, *Zenker & Staudt 432* (holotype, K). Figure 3.

Perennial 15–40 cm tall; roots thin, fibrous; shoots ± tufted, at least in young plants, erect to ascending or decumbent, branching and rooting

Figure 3. *Commelina zenkeri* C. B. Clarke. —A. Habit. —B. Spathe, lateral view. —C. Perfect flower, front view. —D. Capsule, dorsal view. —E. Capsule, lateral view. —F. Seed, dorsal view. —G. Seed, ventral view. All from *Poulsen s.n.* in *University of Copenhagen Botanical Garden P1996–5327* (*SI97–065*), cultivated at the Smithsonian Institution. Illustration by A. R. Tangerini.

only near the base, flowering shoots ascending, unbranched; internodes to 10 cm long at the base of the shoots, much reduced and largely covered by sheaths distally, green, glabrous. Leaves distichous, sheaths 1–2 cm long, not auriculate at the apex, prominently ribbed, green, puberulous with hook-hairs and uniseriate hairs, at least along the fused edge, ciliolate or ciliate at the apex with whitish hairs to 2 mm long; lamina petiolate (or sessile), lanceolate-oblong to lanceolate-elliptic, ovate-elliptic or ovate, (2–)2.5–10.5 × 1–3(–3.7) cm, apex acute to acuminate, rarely rounded (in ovate leaves), base strongly oblique, usually one side rounded, the other side cuneate, margins ± planar, scabrous apically, adaxial surface glabrous to puberulous, sometimes scabrous (with papillae or prickle-hairs), abaxial surface puberulous, especially along the midrib, with hook-hairs, or glabrous, sometimes reddish, "petiole," when present, to 6 mm long, puberulous abaxially. Spathes terminal, solitary or sometimes 2 together, ebracteate or sometimes bracteate, peduncles 4–10 mm long, puberulous with a line of hook-hairs or glabrous except for a few minute hairs at the apex; spathes ± funnelform, 1.2–2 cm long, 0.8–1.3 cm high, not falcate to slightly falcate, apex acute to obtuse, base ± truncate (to cordate), margins fused basally for 2–5 mm, ciliate or ciliolate along the fused portion with hook-hairs, otherwise glabrous, surfaces green, whitish toward the base, sparsely puberulous basally or glabrous; upper cincinnus exserted or enclosed within the spathe, to 17 mm long and puberulous with hook-hairs when exserted, producing 1 male flower, or vestigial, lower cincinnus with peduncle 6.5–9.5 mm long, glabrous, 1–5-flowered, bracteolate. Flowers bisexual and male, 1.4–1.8(–2) cm wide; pedicel of upper cincinnus flower 4.5–6 mm long, pedicels of lower cincinnus flowers 2.5–4.5 mm long; upper sepal ovate or ovate-elliptic to oblong-elliptic or obovate-oblong, strongly hooded at the apex, the apex sometimes deflexed, 2.5–3.5 × 1.7–3 mm, glabrous, hyaline-white or greenish white, lateral sepals ovate-orbicular to obovate-elliptic or ovate-elliptic, 3.3–4.5 × ca. 2.5–3.5 mm, fused laterally for at least 3/4 of their length into a shallow cup, glabrous, hyaline with a whitish midrib; paired petals ca. 9–12 × 8–11 mm, limb broadly ovate or ovate-reniform to ovate-deltate, ca. 5–7 × 8–11 mm, blue or lavender to white, sometimes sky blue except medially where white, apex rounded to slightly emarginate, base truncate to broadly cuneate, margin crenate, undulate, sometimes erose or irregularly cleft, claw 3.5–5 mm long, white; medial petal inconspicuous, lanceolate to lanceolate-elliptic, lanceolate-oblong, oblanceolate or subulate, 2.8–4 × 0.75–1.5 mm, hyaline-white or white, apex rounded; staminodes 3, equal, filaments 3.5–5 mm long, white or whitish in basal 3/4, yellow distally, antherodes often different in form between the medial and lateral staminodes, ± cruciform, although frequently some lobes reduced, ca. 0.7–1.5 × 0.7–1 mm, yellow; lateral stamens with filaments ± parallel or slightly to moderately divergent, gently sigmoid, 5–6 mm long, white or yellowish white, anthers elliptic to ovate, ca. 0.8–1.4 mm long, connective yellow, sutures dark blue, pollen golden yellow; medial stamen with filament pointing forward to slightly recurved, sometimes strongly deflexed at the apex, ca. 3.5–5.5 mm long, white or whitish in basal 2/3, yellow distally, anther saddle-shaped, ca. 1.5–2 mm long, completely yellow or connective yellow and sutures blue, pollen golden yellow; ovary elliptic to orbicular-elliptic or obovate-orbicular in outline, dorsiventrally compressed, ca. 1.3 × 1.1–1.2 mm, densely covered with glandular microhairs, their secretions giving it a papillose appearance, dorsal locule abortive, sometimes represented by a low hump, ventral locules 1-ovulate, style sigmoid, 6–8 mm long, white, grading to bluish purple, lavender, or pale lilac distally, stigma capitate to slightly 3-lobed, pale lilac, lavender, or yellow. Capsules bilocular, bivalved, broadly elliptic, ca. 4–4.5 × 5 mm, the walls thin-textured, apex emarginate, locules 1-seeded. Seeds ellipsoid, ca. 3.5–4 × 2.3–2.5 mm, not compressed, testa dark brown, smooth, densely white-farinose, embryotega concolorous with the testa, with a short, blunt apicule, hilum ± flush with the surface or raised from a ridge, dark brown.

Habitat. Primary forest on rocky hillsides, mixed evergreen forest, *Cynometra alexandri* (Fabaceae) and *Khaya anthotheca* (Meliaceae) forest, closed canopy, mature forest, sandy soils; (750–?)800–1300 m in altitude.

Flowering. Flowering specimens have been seen from August, September, and February.

Chromosome number. $2n = 90$.

Distribution. Western Uganda (U2, of *Flora of Tropical East Africa* (Polhill, 1988)), south-central Cameroon, and possibly eastern Congo (Kinshasa).

Commelina zenkeri is described in detail herein because it has been considered a rare, local endemic of Cameroon. Description of a new equally rare species from Uganda was the original purpose of this exercise, but the putatively undescribed species has proven to be *C. zenkeri.* A history of the Ugandan plant and its eventual connection with *C. zenkeri* may be instructive of how details that are normally lacking in herbarium specimens of this

genus, e.g., floral features, may be decisive in making taxonomic decisions.

Commelina zenkeri was first collected in Uganda in 1969. The collection (*Faden et al. 69/1119*) could not be named, but the plant was considered possibly related to the West African *C. macrosperma* J. K. Morton because of its apparently two-seeded capsules. Ogwal (1977) did not re-collect or discover additional specimens and merely used my provisional name "*Commelina* sp. aff. *macrosperma*." The plant evidently was not collected again until Axel Poulsen found it in the Budongo Forest in 1995. Over the next two years he made two more collections of fertile material in Uganda, as well as sterile plants from plot studies in Uganda and possibly Congo (Kinshasa). At my request he also obtained living material in 1996 that he established at the University of Copenhagen Botanical Garden and later shared with me. His collections, including the living material, formed the basis for the description of the Ugandan plant and for Figure 3.

Clarke (1901) recognized five African species of *Commelina* with two-seeded capsules. Four of them could readily be distinguished from the Ugandan plant: *C. livingstonii* C. B. Clarke—sometimes considered a subspecies of *C. erecta* L.—because of its narrow leaves and appendaged seeds; *C. obscura* K. Schumann and *C. pyrrhoblepharis* Hasskarl, both synonyms of *C. benghalensis* L., which normally has five-seeded capsules; and *C. aethiopica* C. B. Clarke, which I have not seen, but from Clarke's description of the seeds as "subglobose," it clearly was not the Ugandan plant. The type of the fifth species, *C. zenkeri* C. B. Clarke, *Zenker & Staudt 432* (K), had been examined in February 2000, but the small, sessile leaves of the specimen did not strongly resemble the Ugandan plant. No other collections of what appeared to be a rather obscure species had been recognized.

More recently, a *Commelina* collection made in Cameroon in 1986 (*Faden, Satabié & Mpom 86/1*, US) was reexamined. The plant had originally been identified as "*Commelina* sp. cf. *C. bracteosa* Hasskarl" because of its small bracteate spathes and one-seeded capsule locules. The number of locules in the capsules was unclear because the capsules were old and broken. My first impression of the pressed specimen was that it was much larger than the type of *C. zenkeri* and that it resembled the new Ugandan species.

From cultivated plants of *Faden et al. 86/1*, grown from cuttings brought back from Cameroon, a detailed floral description, one seed, three liquid-preserved flowers, and a provisional chromosome count were obtained. It was concluded that the single seed, because of its shape, must have come from a two-seeded capsule. The seed closely resembled that of the type of *C. zenkeri*, as well as that of the Ugandan plant. The provisional chromosome number obtained from *Faden et al. 86/1* was $2n$ = 88–90, which agreed with a chromosome count of $2n = 90$ that Poulsen (in litt.) wrote had been obtained for the Ugandan plant while in cultivation in Copenhagen. It became necessary to either distinguish the Ugandan plant from *C. zenkeri* or to accept it as this species.

A detailed comparison was made among the two collections determined as *C. zenkeri* from Cameroon and the collections from Uganda. No significant differences in vegetative or spathe characters could be found. Moreover, all of the distinctive floral features that were present in the Ugandan plant—sepals highly fused into a shallow cup, limb of the paired petal more or less truncate at the base, claw white, medial petal very small, narrow and inconspicuous, hyaline-white or white, antherodes (staminode anthers) small, with a strong tendency toward reduced lobes, ovary densely covered with glandular microhairs, the secretions from which give it a papillose appearance, and locules two, each one-ovulate—were also present in *Faden et al. 86/1* from Cameroon. The only seed from *Faden et al. 86/1* closely resembled the numerous seeds from the cultivated Ugandan plant of *Poulsen s.n.* in the *University of Copenhagen Botanical Garden P1996–5327* (*SI97–065*) in size, shape, color, and testa pattern.

The following differences were observed. The blue petals in *Faden et al. 86/1* were darker blue than in any Ugandan plant, and their medial white patch was not observed or recorded in the Ugandan plants. The petals in some flowers in the Ugandan plants had a tendency to have erose or notched margins, which was not observed in the Cameroonian plant. Finally, the seed in the Cameroonian plant had a faint, longitudinal mid dorsal ridge, something that was vaguely suggested in one immature seed but was otherwise lacking in the numerous mature seeds of the Ugandan plant.

The Ugandan plants cannot be separated from Cameroonian *C. zenkeri* on any important characters, and therefore they must belong to this species. The differences observed were either inconsistent (petal margins) or of unknown constancy due to the small sample size (e.g., only one mature seed in Cameroonian *C. zenkeri*), so as to render even the recognition of subspecies untenable.

Specimens that are definitely this species have been seen only from western Uganda and south-central Cameroon. *Poulsen 1186* (C), from Congo

(Kinshasa) (Haut Zaïre Dist.: Okapi Wildlife Reserve, Ituri Forest, NE of Edoro River, 1°33′N, 28°32′E, alt. 750 m, mixed forest in open patch, 11 Mar. 1996) is sterile but closely resembles the Ugandan plants of *C. zenkeri*. Its occurrence in this location would not be unexpected, but fertile material is essential for confirmation. A search through the herbarium of the National Botanic Garden of Belgium (BR) in September 2000 failed to turn up any specimens of *C. zenkeri*, but the search was hardly exhaustive. Similarly, further specimens from Cameroon may have been overlooked or misidentified as *C. bracteosa*.

The relationships of *C. zenkeri* are uncertain. It strongly resembles *C. disperma* and has a similar capsule. For differences, see the discussion herein. They both belong to a species group that includes *Commelina erecta* and *C. bracteosa*, which is characterized by one-ovulate ovary locules, one-seeded capsule locules, fused lateral sepals, usually blue flowers, very reduced lower petal, and the presence of hook-hairs on the leaves. *Commelina bracteosa*, some forms of which resemble *C. zenkeri*, differs primarily by its trilocular, trivalved capsules and subspherical seeds that have a very long apicule on the embryotega. *Commelina erecta* has very narrow leaves, auricles at the summit of the sheath, and appendaged seeds.

The apparent disjunct distribution of *C. zenkeri* at the eastern and western ends of the Congolian forest could have several explanations. It could be an artifact of under-collecting, a manifestation of unrecognized or wrongly named herbarium specimens, or it could be real. *Commelina* species tend to be under-collected because they may be weedy, hard to dry, and difficult to recognize to species in the field. Clearly, *C. zenkeri* specimens may well have been overlooked in herbaria or mistaken for other species. A truly disjunct distribution is also possible. Based on the distributions of plants and animals, Pleistocene refugia have been postulated for the western end of the Congolian forest, which includes the part of Cameroon where *C. zenkeri* occurs, and for the eastern end of this forest, with rainforest having disappeared in the intervening region (Hamilton, 1976; Mayr & O'Hara, 1986). The sterile collection from Congo (Kinshasa) that may be *C. zenkeri* comes from this eastern refugium, whereas the Ugandan plants are from just east of the refugium. Among Commelinaceae the only other species considered to have a similar distribution was an undescribed species of *Polyspatha*, but recent herbarium research has revealed that it also occurs in Ivory Coast, Congo (Brazzaville), and in parts of Congo (Kinshasa) that have not been postulated to have been refugia.

Specimens seen. CAMEROON: **South-Central Prov.:** Nkolbisson, 8 km W of Yaoundé, Akouandoué Hill, S of the town, 3°51′N, 11°28′E, alt. 745–950 m, 23 Jan. 1986, *Faden, Satabié & Mpom* 86/1 (US). UGANDA. U2. **Bunyoro Dist.:** [Masinde Dist. on label]: Budongo Forest Reserve, The Nature Reserve, 1°43′N, 31°31′E, 1000 m, 30 Aug. 1995, *Poulsen (with Nkuutu & Dumba) 863* (C, K, US); Budongo Forest Reserve, Kanyo-Pabidi Block, 1°56′N, 31°44′E, 950 m, 1 Feb. 1996, *Poulsen 1106* (C, US). **Kigezi Dist.:** just outside Queen Elizabeth National Park, South Maramagambo Central Forest Reserve, 4–7 mi. [6.4–9.2 km] up Kaizi–Bitereko road, 18 Sep. 1969, *Faden, Evans, Lye & Lock 69/1119* (EA). **Toro Dist.:** [Kabarole Dist. on label]: Kibale National Park, S of Ngogo Camp, 0°32′N, 30°23′E, 1300 m, 6 June 1997, *Poulsen 1314* (K, US).

Acknowledgments. I thank Axel D. Poulsen for collecting living material of *Commelina zenkeri* from Uganda; Lisbeth Knudsen, University of Copenhagen for obtaining the chromosome count for *Commelina zenkeri* from Uganda; the University of Copenhagen and the Royal Botanic Gardens, Kew, for the loan of specimens; the Royal Botanic Gardens, Kew, for allowing me to participate and partly funding my participation in the 1996 Kew Expedition to Southern Tanzania, during which the type of *Commelina kituloensis* was collected; Sylvia M. Phillips for her valiant driving during this expedition, A. M. Muasya and E. Macha for their help during the expedition; Alice R. Tangerini for the illustrations; and my wife, Audrey J. Faden, for maintaining my research collections for many years.

Literature Cited

Clarke, C. B. 1901. Commelinaceae. Pp. 25–88 *in* W. T. Thiselton-Dyer (editor), Flora of Tropical Africa, Vol. 8. Lovell, Reeve, London.

Faden, R. B. 1994. New species of *Commelina* (Commelinaceae) from the Flora of Tropical East Africa. Novon 4: 224–235.

——— & M. H. Alford. 2001. A new species of *Commelina* (Commelinaceae) from Tanzania. Novon 11: 16–21.

——— & Y. Suda. 1980. Cytotaxonomy of Commelinaceae: Chromosome numbers of some African and Asiatic species. Bot. J. Linn. Soc. 81: 301–325.

Hamilton, A. C. 1976. The significance of patterns of distribution shown by forest plants and animals in tropical Africa for the reconstruction of upper Pleistocene palaeoenvironments: A review. Pp. 63–97 *in* E. M. van Zinderen Bakker (editor), Palaeoecology of Africa, Vol. 9. Balkema, Cape Town, Rotterdam.

Lewis, W. H. 1964. Meiotic chromosomes in African Commelinaceae. Sida 1: 274–293.

Mayr, E. & R. J. O'Hara. 1986. The biogeographic evidence supporting the Pleistocene forest refugia hypothesis. Evolution 40: 55–67.

Morton, J. K. 1956. Cytotaxonomic studies of the Gold Coast species of the genus *Commelina* Linn. J. Linn. Soc. Bot. 55: 507–531.

———. 1967. The Commelinaceae of West Africa: A biosystematic survey. J. Linn. Soc. Bot. 60: 167–221.

Ogwal, E. N. K. 1977. A Taxonomic Study of the Genus *Commelina* in Uganda. M.Sc. Thesis, Makerere University, Kampala.

Polhill, D. 1988. Flora of Tropical East Africa: Index of Collecting Localities. Royal Botanic Gardens, Kew.

Taxonomic Novelties in American *Agave* (Agavaceae)

Wendy C. Hodgson
Desert Botanical Garden, 1201 N. Galvin Parkway, Phoenix, Arizona 85008, U.S.A.

Abstract. In the course of preparing a taxonomic treatment of *Agave* (Agavaceae), recognition of four taxonomic novelties is needed. *Agave phillipsiana* is a new, rare species known only from four sites in Grand Canyon National Park and is distinguished by its open rosette, large glaucous leaves, narrowed paniculate inflorescence, and large flowers. Two new combinations are proposed: *Agave deserti* var. *pringlei* (Gentry) W. C Hodgson & Reveal and *A. deserti* var. *simplex* (Gentry) W. C. Hodgson & Reveal. A new interspecific hybrid, *Agave* ×*ajoensis* is described. The hybrid is known from a single population restricted to Organ Pipe Cactus National Monument with *A. deserti* var. *simplex* and *A. schottii* var. *schottii* as putative parent taxa.

Key words: Agavaceae, *Agave*, North America.

During the past two decades, the author has been investigating the taxonomy and systematics of *Agave* within the United States and northern Mexico, including those taxa whose distributions were affected by human activities (Hodgson, 1999a, 1999b, 2001; Hodgson & Slauson, 1995). In the course of preparing a taxonomic treatment of *Agave* for the *Flora of North America*, the recognition of four taxonomic novelties is needed.

Agave phillipsiana W. C. Hodgson, sp. nov. TYPE: U.S.A. Arizona: Coconino County, Grand Canyon National Park, Clear Creek Canyon, ca .7 mi. upstream from camping area, 1140 m, 36°07.381′N, 112°00.568′W, 13 Sep. 1999, *W. C. Hodgson 11861* (holotype, DES 44332; isotypes, GCNP, MO photo). Figure 1.

A. delamateri et *A. palmeri* affinis sed inflorescentia angustiore, floribus grandioribus, numero chromosomatum, et distributione restricta praecipue differt.

Rosettes caespitose, open, ca. 7.5–10 dm high and broad. Leaves numerous, lanceolate, 76–78 × 11 cm, firm, slightly glaucous green to dark green, with a very lightly cross-zoned pattern, acuminate, ascending to spreading, concave toward apex, thickish and convex toward base; margins straight or undulate; teeth variable, 4–7 mm long, upturned or reflexed, weakly attached, red-brown aging to gray, 1–2.5 cm apart; interstitial teeth (2)3 to 7 on upper 2/3 of leaf; terminal spine 2.5–4 cm long, slender, openly grooved, dark brown to gray, decurrent to upper teeth. Inflorescence with scape 2.7–5.5 m high, narrowly paniculate, open, with 9 to 16 short, lateral, slightly ascending to becoming perpendicular, maroon-glaucous branchlets in upper 1/3–1/2; stalk maroon-glaucous. Flowers in dense clusters of 32 to 45, 68–86 mm long, thick, durable, fragrance unknown; ovary light chartreuse cream, 29–46 mm long, thick, with slightly constricted neck 4–8 mm long; style light chartreuse cream flecked with maroon, 60–78 mm long when stigma is receptive; floral tube chartreuse cream, 15.5–20 × 15–23 mm, very thick, bulging at base of tepal lobes; tepal lobes leathery, erect and persistent, clasping filaments, unequal, with the outer three 20–21.5 × (5–)8–12 mm, broadly lanceolate, whitish cream with tinge of light green, becoming dark maroon at anthesis, with brown-maroon felt-like rugose hooded tips, those of the inner three 15–19 × (4–)5–8 mm, strongly keeled, similarly colored and tinged; filaments light chartreuse cream, flecked with maroon, 48–64 mm long, the sets unequally inserted 7.5–11 mm and 9–12 mm above base of tube, the anthers yellow, 17–25 mm long. Capsules and seeds unknown. Chromosome number: $2n$ = ca. 120 (Baker, pers. comm., meiotic count from *Hodgson 8357A*).

Phenology. Flowers in September.

Agave phillipsiana is a very rare plant, known only from four sites within Grand Canyon National Park. By naming *A. phillipsiana* formally, greater interest may develop in the plant, which may result in further survey and monitoring work, particularly at a time when archaeological inventorying is a major area of focus within the Grand Canyon. No one has visited one site since its discovery by Stuart Aitchison in 1976. The other three sites have from 1 to 30 or more plants (offsets). *Agave phillipsiana* experiences a significant amount of protection in that the plants occur within a National Park in relatively rugged terrain. However, they may be in jeopardy by their own low number of individuals, hiker activity (in 1996 a camper-caused fire at the type locality burned a number of plants), possible rodent predation, or flash floods. Reproduction ap-

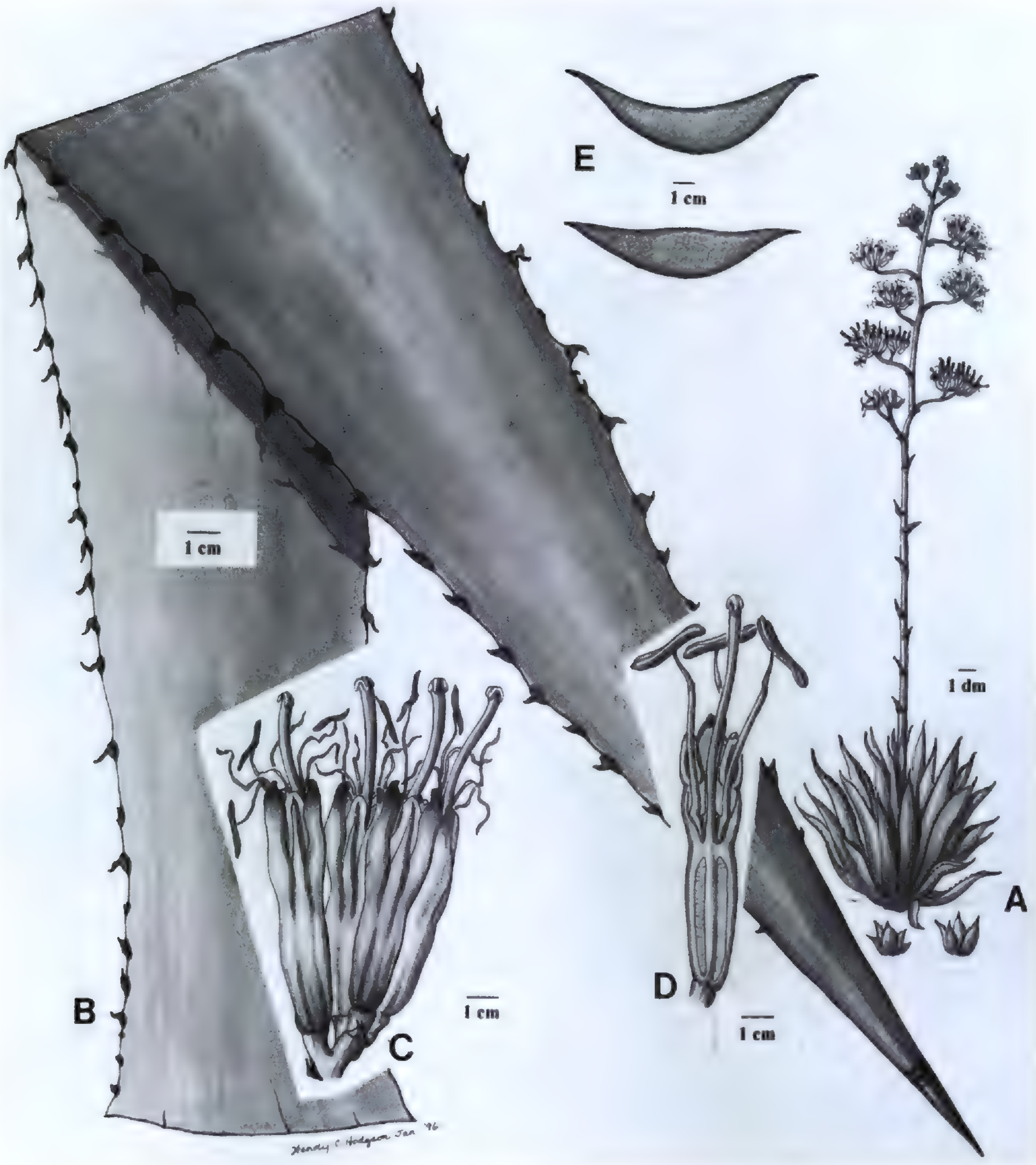


Figure 1. *Agave phillipsiana* W. C. Hodgson. —A. Plant habit with rhizomatous offsets ("pups"). —B. Leaf. —C. Cluster of flowers. —D. Longitudinal section of flower. —E. Leaf base cross section. Drawn from *Hodgson 8357B* and *Brian s.n.*

pears to be by vegetative means only, as no fruits have ever been found on old inflorescences. It is hoped that plants grown at the Desert Botanical Garden can be reintroduced to their respective sites.

Agave phillipsiana is found on terraces along permanent waterways at 700 to 1140 m. Three of the four sites are near pre-Columbian agricultural features or habitation sites. Two sites occur near a Kayenta-Anasazi Pueblo cliff dwelling (1000–1150 A.D.), on a terrace presumably once farmed by the early inhabitants. *Agave phillipsiana* is an ancient, relictual cultivar, one of four agaves intentionally introduced and farmed by pre-Columbian people for food or fiber north of the Mexican border. The others, *Agave murpheyi* F. Gibson and *A. delamateri* W. C. Hodgson & Slauson of central Arizona (see Hodgson & Slauson, 1995; Hodgson, 1999b, 2001), and *A. decipiens* Baker of Florida (Gentry, 1982) all seem to represent isolated populations of agaves that probably are the result of human intervention.

Agave phillipsiana clearly belongs within Gentry's (1982) informal group Ditepalae. The 13 taxa that comprise this group are found from central Arizona south to Veracruz and Puebla. Gentry (1982) believed these agaves to be among the more highly

Table 1. Comparison of *Agave palmeri*, *A. delamateri*, and *A. phillipsiana*, sp. nov.

	A. palmeri	*A. delamateri*	*A. phillipsiana*
Habit	usually solitary	strongly cloning	strongly cloning
Leaf length (cm)	35–92	50–74	76–78
Leaf orientation	spreading, flaring at tip	erect-ascending, incurved at tip	ascending to spreading, flaring at tip
Leaf color	light glaucous green to dark green with purplish tinge	bluish gray glaucous with purplish tinge	glaucous green to dark green
Interstitial teeth	4–6 on upper ⅔ of leaf	6–12 on upper ⅔ of leaf	3–7 on upper ⅔ of leaf
Flower stalk height (m)	(1.75–)4–7	4.5–6	2.7–5.5
Inflorescence shape	open, broadly paniculate	open, broadly paniculate	open, narrowly paniculate
Orientation of lateral branches	perpendicular to stalk, in upper ⅓ of stalk	perpendicular to stalk, in upper ⅗–⅝ of stalk	ascending to perpendicular to stalk, in upper ⅓–½ of stalk
Flower length (mm)	46–64	47–70	68–86
Ovary length (mm)	18–36	21–29	29–46
Floral tube length, width (mm)	10–18 × 10–16	11–16 × 11–16	15.5–20 × 15–23
Outer & inner tepal length (mm)	12–18, 6.5–14	14–18, 9–15	20–21.5, 15–19
Filament insertion	at 2 levels	equally	subequally
Distribution	SE Arizona, New Mexico, Sonora	central Arizona	N-central Arizona
Chromosome no.	$2n = 60$ (Pinkava & Baker, 1985)	$2n = ?$	$2n =$ ca. 120

advanced in the genus. All possess strong erect flowers with short leathery, persistently erect, unequal tepal lobes and deep floral tubes. Of all the members of the Ditepalae, *A. phillipsiana* appears to most closely resemble *A. delamateri* and *A. palmeri* Engelmann, in having large flowers with leathery, erect, persistent tepal lobes, these cream-green with maroon or rust-colored tips, and filaments and styles cream flushed with maroon. It differs from *A. delamateri* by its leaf shape, color, and size, flowering stalk length, narrower inflorescence, ascending lateral branches, flower size, chromosome count, and flowering period. It differs from *A. palmeri* by its offsetting habit, marginal teeth, shorter flowering stalk, narrower inflorescence, flower size, filaments inserted at same level, and chromosome count (Fig. 1, Table 1). There is no evidence that *A. phillipsiana* evolved from a hybridization event involving other extant members of the Ditepalae. Whether or not Grand Canyon *A. phillipsiana* plants are the only surviving remnants of an undescribed species now extirpated in northern Mexico is not known.

Agave utahensis Engelmann is the northernmost species of the genus, inhabiting areas experiencing cold temperatures. The most common agave in the eastern half of Grand Canyon National Park where *A. phillipsiana* occurs is *A. utahensis* subsp. *kaibabensis* (McKelvey) Gentry. It, too, has been used for food or fiber (Hodgson, 2001). Compared to *A. phillipsiana*, the usually solitary rosette of *A. utahensis* subsp. *kaibabensis* is compact and its leaves are short, numerous, heavily toothed, rigid, and fibrous. Its compact rosettes and shorter leaves are characteristic of agaves whose growth is limited by low temperature. Natural selection favors shorter leaves and more compact rosettes because they have less radiant and convective exchange with their environment (Burgess, 1985). *Agave phillipsiana* is a larger, more open plant with longer and fewer leaves, characteristic of agaves that have evolved in a more subtropical frost-free environment. In addition, its paniculate inflorescence differs significantly from the narrowly racemose inflorescence of *A. utahensis* subsp. *kaibabensis*.

The more limited distribution, sporadic occurrence, and growth habit (open rosette of long, fewer leaves) of *A. phillipsiana* strongly imply that the species is not native to the Grand Canyon region; like *A. murpheyi* and *A. delamateri*, *A. phillipsiana* was probably transported from relatively frost-free areas of northern Mexico (Hodgson & Slauson, 1995; see Gentry, 1985: 425). *Agave murpheyi* and *A. delamateri* also occur as sporadic clones, the majority of which are directly or indirectly associated with pre-Columbian agricultural features (see

Hodgson, 2001). Like these two agaves, *A. phillipsiana* possesses traits that would be advantageous to those harvesting it for food or fiber. Compared to *A. utahensis* subsp. *kaibabensis*, *A. phillipsiana* produces relatively large, open rosettes that produce numerous rhizomatous offsets. Their long leaves are not as rigid as *A. utahensis* subsp. *kaibabensis* and are very easy to cut.

Agave phillipsiana was probably not cultivated as extensively as *A. murpheyi* and *A. delamateri*, being limited in this rugged terrain to the large side drainages having permanent water, which occur primarily on the north side of the Colorado River. In contrast, *A. murpheyi* was probably grown over hundreds of acres on low-gradient slopes and benches characteristic of the relatively dry Lower Colorado subdivision of the Sonoran Desert. Extensive agricultural features such as linear rock alignments and checkdams were constructed in pre-Columbian times to supply needed moisture to the agaves. *Agave delamateri* was probably cultivated fairly extensively atop old terraces and hilltops overlooking drainages, characteristic of the topography of the more mesic Arizona Upland subdivision of the Sonoran Desert. Within the drainages less drought-resistant crops were grown in association with agricultural features.

Of significance, too, is the dominating presence in Clear Creek and other drainages within the Grand Canyon (such as Bright Angel and Tapeats) of extensive populations of *Opuntia engelmannii* Salm-Dyck var. *engelmannii* producing red flowers (normally flowers are yellow throughout) and exceptionally large pads and fruits. It is suggested that these plants were not only cultivated by early inhabitants (Hodgson, 1999b, 2001), but were probably intentionally introduced into these areas from the south for domestic purposes (Pinkava, pers. comm.). *Agave phillipsiana* also occurs along Clear and Tapeats creeks.

This beautiful agave is named in honor of Arthur Phillips III, who informed the author of this species in 1994 and has watched over the plants diligently for years. He has also contributed enormously to our understanding of the flora of Grand Canyon National Park.

Paratypes. U.S.A. **Arizona:** Coconino County, Grand Canyon National Park, Deer Creek Canyon, 36°23′52.2″N, 112°30′32″W, 731 m, 11 June 1994, *Hodgson et al. 8357B* (DES, GCNP, MO photo), 14 Aug. 1995, *Hodgson 8357A and Brian* (DES, GCNP), 26 Sep. 1995, *Brian s.n.* (ASU, DES, GCNP, MO); Grand Canyon National Park, Clear Creek Canyon, ca. 0.7–1 mi. upstream from camping area, 36°07.381′N, 112°00.568′W, 1140 m, 29 Apr. 1999, *Hodgson et al. 11472* (DES, GCNP, MO photo); same area only 100 m further upstream, 37°07.592′N, 112°00.324′W, 1145 m, 29 Apr. 1999, *Hodgson et al. 11473* (DES, GCNP, MO photo).

Two new changes in status are proposed:

Agave deserti Engelmann var. **pringlei** (Gentry) W. C. Hodgson & Reveal, stat. nov. Basionym: *Agave pringlei* Engelmann ex Baker, Handbook Amarillid. 182. 1888. *Agave deserti* Engelm. subsp. *pringlei* Gentry, Occas. Pap. Calif. Acad. Sci. 130: 20. 1978. TYPE: Mexico. Baja California: Sierra Centrales, elev. 6000 ft., 7 Oct. 1882, *C. R. Orcutt s.n.* (holotype, K not seen; isotype, MEXU not seen).

Agave deserti Engelmann var. **simplex** (Gentry) W. C. Hodgson & Reveal, stat. nov. Basionym: *Agave deserti* subsp. *simplex* Gentry, Occas. Pap. Calif. Acad. Sci. 130: 22. 1978. TYPE: U.S.A. Arizona: Yuma Co., N slope of Harquahala Mt., 12 mi. (ca. 19 km) W of Aguila, 12 June 1974, *H. S. Gentry 23404* (holotype, US; isotypes, DES, MEXU not seen).

With the impending publication of *Agave* for the *Flora of North America* by Reveal and myself, status changes for two entities within *Agave deserti* are published here. Gentry described *A. deserti* as a large variable complex whose limits were hard to define (Gentry, 1978: 16). After "considerable study and vacillation," Gentry separated three main *A. deserti* geographic populations "none of which is in all individuals morphologically distinct" (Gentry, 1978: 18). He proposed *A. deserti* subsp. *pringlei* for scattered populations bordering *A. deserti* subsp. *deserti* to the south and west. *Agave deserti* subsp. *simplex* was proposed by Gentry for those expressions of the species with a simple, non-cloning habit to the east of the other two subspecies. The distributions of *A. deserti* var. *pringlei* and variety *deserti* overlap, while *A. deserti* var. *simplex* is disjunct by approximately 160 km. Without the presence of any consistent morphological distinctions (such as leaf size, flower tube depth, filament insertion, and habit) within the species, Gentry's subspecies are reduced to varietal status, reflecting variations within the larger species complex.

Specimens examined:

Agave deserti var. *pringlei*: MEXICO. **Baja California Norte:** just E of El Progreso, Sierra Juarez, near 32°17′N, 115°56′W, *Harbison s.n.* (DES); Sierra San Pedro Martir, ca. 18.5 mi. E of Meling Ranch, *McGill 555 & Moulis* (DES); 0.6 mi. N of Route 3 at Ejido San Matias, between Ensenada and San Felipe, 31°21′N, 115°32′W, *Rebman et al. 2674* (DES).

Agave deserti var. *simplex*: U.S.A. **Arizona:** Maricopa Co., San Tank Mountains, 18 mi. E of Interstate 8, *Gentry*

23556 (DES); Pima Co., S end of Silver Bell Mountains, *Gentry 23562 & Engard* (DES); Mohave Co., 40–45 mi. S of Yucca along Alamo Road, *Gentry 23658 & Whitehead* (DES).

Agave ×ajoensis W. C. Hodgson, hybr. nov. TYPE: U.S.A. Arizona: Pima County, Organ Pipe Cactus National Monument, Ajo Mountains, infrequent on rocky slopes at Bull Pasture, 980 m, 32°00′45″N, 112°42′00″W, 14 Mar. 1987, *W. C. Hodgson 4478 with R. DeLamater & J. Ramsden* (holotype, DES 30831; isotype, ORPI). Figure 2. [*A. deserti* Engelmann var. *simplex* (Gentry) W. C. Hodgson & Reveal × *A. schottii* Engelmann var. *schottii*.]

Agave schottii var. *schottii* similis sed foliis grandioribus crassioribusque, absentia fibrarum marginalium, inflorescentia subspicata ad anguste racemosopaniculata, floribus grandioribus aureis differt. Ab *Agave schottii* var. *treleasei* foliis latioribus, rectioribus, subviridibusque et floribus paucioribus per fasciculo differt. Ab *Agave deserti* var. *simplex* foliis angustioribus emarginatis, inflorescentia spicata ad subspicata, et fasciculis parvis florum tubis floralibus longis *A.* ×*ajoensis* differt.

Rosettes solitary or more commonly caespitose, ca. 1.9–4 dm high, 2.5–4.5 dm broad. Leaves several, linear-lanceolate, 16–34 × 1.5–3 cm, rigid, light green, sometimes with lighter green midstripe, acuminate, usually spreading to slightly falcate, shallowly concave toward apex, thickly convex at base; margins straight with two narrow borders of reddish brown and white, which are continuous to base, non-filiferous, teeth absent except for small interstitial teeth near base of leaf; terminal spine 1.5–2.5 cm long, subulate, shallowly grooved above, reddish brown, aging gray, decurrent with border. Inflorescence with scape 2.5–3.5 m tall, subspicate to narrowly racemose-paniculate, with 30 to 40 lateral branchlets on upper 1/3, these 0.4–2.7(–4) cm long; scape slender, green. Flowers in close-set clusters of 3 to 6, 32–53 mm long, durable, with a strong, sweet fragrance, long-lingering even when dried; ovary chartreuse-green, 10–17 mm long, thick, with constricted, somewhat angled ovarian neck 2–6 mm long, making the flower somewhat zygomorphic; style yellow, 19–27 mm long when stigma receptive; floral tube chartreuse-green, (4–)6–21 × 8–13 mm, deeply funnelform, narrowed below; tepal lobes golden yellow, slightly unequal, 10–20 × 2–8 mm, broadly lanceolate with blunt tips, erect to ascending, unequally spreading to reflexed at anthesis, wilting within one to two days after anthesis; filaments light yellow, (17–)20–30 mm long, inserted equally or subequally high in tube at 6–16 mm above base; anthers yellow, 9–14 mm long. Fruits a capsule, 12–21 × 10–16 mm, elliptic, apiculate; seeds unknown.

Phenology. Flowers from June through July.

Agave ×*ajoensis* was first found by C. L. Fouts in 1948. His specimen was tentatively identified as *Agave schottii* Engelmann var. *treleasei* (Toumey) Kearney & Peebles (Gentry, 1982). The new hybrid is known from 28 clones or individual plants on rocky slopes within a 3 km² area of Bull Pasture in the Ajo Mountains between 900 and 1050 m in elevation. It is to be expected in Cerro Cubabi and Cerro Cozon of northwestern Sonora, areas where *Agave schottii* var. *schottii* and *A. deserti* var. *simplex* are sympatric.

Agave ×*ajoensis* is of hybrid origin involving putative parents, *Agave deserti* var. *simplex* of the subgenus *Agave* and *A. schottii* var. *schottii* of the subgenus *Littaea*. It is a triploid, having a chromosome number of $2n = 90$ (Pinkava et al., 1992). In the same area *A. deserti* var. *simplex* is a diploid ($2n = 60$) (Pinkava et al., 1992), while *A. schottii* var. *schottii* is a tetraploid race ($2n = 120$) (Pinkava et al., 1992). The narrowly racemose to subspicate inflorescence of *A.* ×*ajoensis* is similar to other agaves suspected of being of hybrid origin involving hybridization between *Agave* subg. *Littaea* (with a spicate or rarely racemose inflorescence) and *Agave* subg. *Agave* (with a paniculate inflorescence). The wider, ascending leaves without marginal fibers and larger golden flowers of *A.* ×*ajoensis* may reflect the contribution of *A. deserti* var. *simplex* (Table 2, Fig. 2). The toothless, green leaves, the slightly irregular, fragrant flowers, and the deep floral tube show strong affinities to *A. schottii* var. *schottii*. Such hybrid taxa (or individuals included within the taxon) encountered in the United States that have or may have involved such a cross between subgenera include *A.* ×*arizonica* Gentry & Weber (originally described as a distinct species by Gentry and Weber), *A. glomeruliflora* (Engelmann) Berger, *A. gracilipes* Trelease, and *A. schottii* var. *treleasei*. Numerous individual plants suggesting such gene flow at the subgeneric level have also been observed or documented in Arizona (Hodgson, 1999a) and Mexico (Pinkava & Baker, 1985).

Paratypes. U.S.A. **Arizona:** Pima County, Organ Pipe Cactus National Monument, 1 May 1948, *Fouts s.n.* (US, DES [photocopy]); Ajo Mountains, Bull Pasture, 980–1036 m, 14 Mar. 1987, *Hodgson et al. 4472* (DES), *4473* (DES), *4474* (DES), *4475* (DES), *4476* (DES), *4477* (DES), *14391* (DES), *14392* (DES); Ajo Mountains, Bull Pasture, 980–1036 m, 14 Mar. 1987, *DeLamater 23487 & Hodgson* (DES), *DeLamater 23587* (DES), *23687* (DES), *23787* (DES), *23887* (DES), *23987* (DES), *24187* (DES), *24287* (DES), *24387* (DES); Ajo Mountains, Bull Pasture, 980–1036 m, 14 July 1987, *Hodgson 4621 & DeLamater*

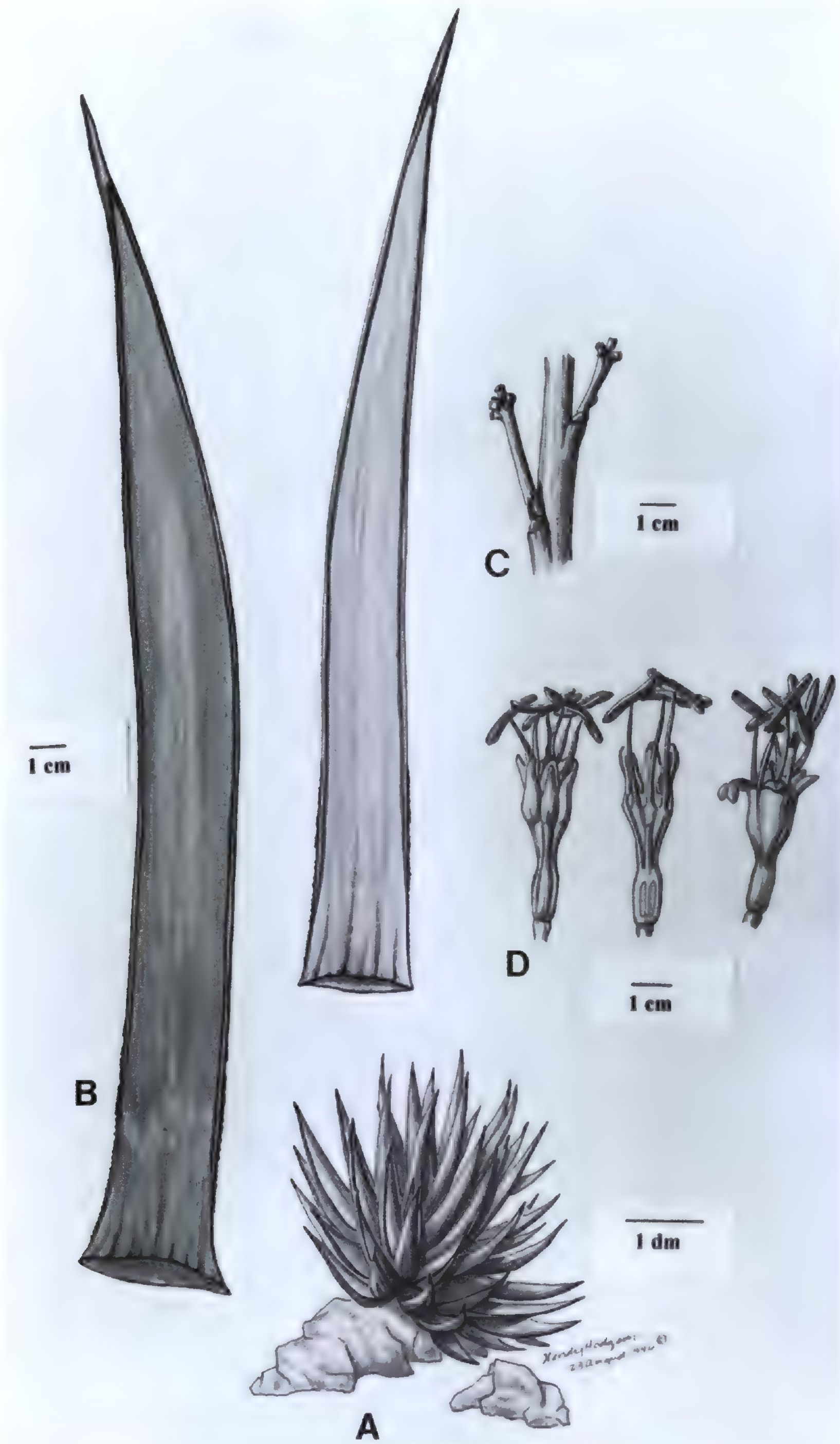


Figure 2. *Agave ×ajoensis* W. C. Hodgson. —A. Plant habit. —B. Leaves, adaxial view. —C. Portion of inflorescence axis showing peduncles. —D. Flowers, whole and longitudinal section. Drawn from *Hodgson 4478A with DeLamater & Ramsden* and *Hodgson et al. 4472.*

(DES); Ajo Mountains, Bull Pasture, 914 m, 1 Mar. 1989, *Hodgson 5420 & DeLamater* (DES), *Hodgson 5421* (DES), *5422* (DES); Ajo Mountains, Bull Pasture, 975 m, *Hodgson 6972 & Slauson* (DES); Ajo Mountains, Bull Pasture, 914 m, 25 June 1990, *Hodgson 6015 & Slauson* (DES); Ajo Mountains, Bull Pasture, 850 m, 18 Dec. 1999, *Hodgson & Prince 11901* (DES), *Hodgson 11902* (DES), *11903* (DES).

Acknowledgments. I am grateful to the staff at Grand Canyon National Park, particularly Nancy Brian, Robert Winfree, and Della Snyder, the staff

Table 2. Comparison of *Agave schottii* var. *schottii*, *A.* ×*ajoensis*, and *A. deserti* var. *simplex*.

	A. schottii var. *schottii*	*A.* ×*ajoensis*	*A. deserti* var. *simplex*
Habit	strongly falcate, densely caespitose	straight-ascending to slightly falcate, single or more often caespitose	straight, stiff, mostly single
Leaf width (mm)	7–12	15–30	45–100
Leaf armature	fibers present	fibers absent, very small teeth near leaf base	large and small teeth present
Leaf color	light green with bud imprinting	light green with bud imprinting	light green to light glaucous gray
Lateral branchlet length (mm)	0.5–2	4–40	ca. 50–150
Number of flowers per cluster	2–3	3–6	ca. 10–20+
Flower length (mm)	29–42	32–53	30–60
Flower color	light yellow	golden yellow	yellow to light yellow
Ovary and "neck" length (mm)	8–15, 3–9, curved	10–17, 2–6, slightly curved	15–30, 4–6, straight
Floral tube length, width (mm)	8–11(–14), 5–8	(4–)6–21, 8–13	3–10, 5–10
Distribution	Cochise, Graham, Pima, Santa Cruz Cos., Arizona; N Sonora, Mexico	Pima Co., Arizona	La Paz, Maricopa, Mohave, Pima, Pinal, Yuma Cos., Arizona; SE California
Chromosome no.	$2n = 60$ (Granick, 1944), 120	$2n = 90$	$2n = 60$

at Organ Pipe Cactus National Monument, and the Arizona Columbine Club. In addition, I thank James Reveal and Donald Pinkava for critically reviewing the manuscript and for their contributions. I am also grateful to David Keil who provided the Latin diagnoses.

Literature Cited

Burgess, T. 1985. Agave adaptation to aridity. Desert Pl. 7: 39–50.

Gentry, H. 1978. The agaves of Baja California. Occas. Pap. Calif. Acad. Sci. No. 130.

———. 1982. Agaves of Continental North America. Univ. Arizona Press, Tucson.

Granick, E. 1944. A karyosystematic study of the genus *Agave*. Amer. J. Bot. 31: 283–298.

Hodgson, W. 1999a. Agavaceae. Part One. *Agave*. J. Arizona-Nevada Acad. Sci. 32: 1–21.

———. 1999b. Agaves and humans: The continuing story of a continuing connection. The Sonoran Quart. 53(4): 6–8.

———. 2001. Food Plants of the Sonoran Desert. Univ. Arizona Press, Tucson.

——— & L. Slauson. 1995. *Agave delamateri* (Agavaceae) and its role in the subsistence patterns of pre-Columbian cultures in Arizona. Hazeltonia 3: 130–140.

Pinkava, D. & M. Baker. 1985. Chromosome and hybridization studies of agaves. Desert Pl. 7: 93–100.

———, M. Baker, R. Johnson, N. Turshell, G. Ruffner, R. Felger & R. Van Devender. 1992. Additions, notes and chromosome numbers for the flora of vascular plants of Organ Pipe Cactus National Monument, Arizona. J. Arizona-Nevada Acad. Sci. 24–25: 13–18.

Two New Infraspecific Taxa in Florida *Dicerandra* (Labiatae)

Robin B. Huck
Florida Museum of Natural History, Gainesville, Florida 32611, U.S.A.

ABSTRACT. A new subspecies, *Dicerandra frutescens* Shinners subsp. *modesta* (Labiatae), is described for Florida. Occurring only in Polk County, this new taxon is distinguished from *D. frutescens* subsp. *frutescens* in Highlands County by the number of flowers per cyme, corolla coloration, shape of the upper lip of the corolla, and chromosome number. A new variety, *D. immaculata* Lakela var. *savannarum*, is described from east coastal Florida and is separated from *D. immaculata* var. *immaculata* by its wider leaves and lax habit.

Key words: *Dicerandra*, endemic, Florida, Labiatae, Lake Wales Ridge, North America.

Dicerandra, an endemic mint genus of the southeastern United States, is characterized by spur-like appendages on the anthers that serve as trigger mechanisms in pollen dispersal (Huck, 1987, 1992). Nine species comprise the genus, including five perennials found on old, isolated dune ridges in Florida. Discovery by Huck and Chambers (1997) of chromosomal differences in populations of one of these perennials, *D. frutescens* Shinners as currently recognized (Wunderlin, 1998), has led to the re-examination of a disjunct population on the northern Lake Wales Ridge, in Polk County, Florida. Consequently, the new subspecies *D. frutescens* subsp. *modesta*, found 24 km north of *D. frutescens* subsp. *frutescens*, is described herein. Further, *D. immaculata* var. *savannarum*, a new variety, is described for east-central Florida. Types of *D. frutescens* (Shinners, 1962) and *D. immaculata* (Lakela, 1963) are reviewed.

1. **Dicerandra frutescens** Shinners subsp. **modesta** Huck, subsp. nov. TYPE: U.S.A. Florida: Polk Co., Black Road, E of Dundee, Florida, sandy ridge, 30 m, 9 Sep., 1999, *R. B. Huck 5555* (holotype, FLAS; isotypes, MO, USF). Figure 1A–D.

Haec subspecies a *Dicerandra frutescente* Shinners subsp. *frutescente* cyma 2- vel 3- (vs. 1- vel 2-)flora, corolla alba plerumque erubescente (vs. alba) delicata (vs. firma) vexillo ovato (vs. lingulato) atque chromosomatum numero $n = 16$ (vs. $n = 24$) distinguitur.

Suffruticose chamaephyte to 0.5 m tall, with erect herbaceous flowering shoots arising from a perennial, ramose woody base; internodes on flowering branches at mid branch 1.4–2.2 cm; leaves epetiolate, narrowly oblanceolate, at mid branch 0.8–2.0 cm long, 1.0–3.5 mm wide, minty odor when crushed; leaves of herbaceous shoots slightly wider than those of vegetative woody base; leaf margins entire; surface glandular pitted adaxially and abaxially with sessile 8-parted glands. Inflorescence a verticillaster with 1–6-flowered cymes, usually 2- or 3-, developing in opposing axils on peduncles 1.0 mm long, pedicels 5 mm long. Buds yellow, and upon opening, corolla cream-yellow, usually turning to pink or pinkish white and then blushing to darker pink with age and upon drying. Flowers bilateral, 2-lipped with upper lip an upright banner or standard (as opposed to sect. *Lecontea* in this genus), and the lower lip parted into 3 lobes. Calyx 6–9 mm long, 2–5 mm wide, 13-ribbed, bilabiate with lower lip sharply bidentate and upper lip with two strongly winged ridges meeting at summit, bordered by a white ciliate-margined and glandular-pitted band. Corolla delicately membranaceous, glandular-dotted and pubescent; tube slender, ca. 1 mm wide, the neck lined with abundant glandular hairs, geniculate to 90° then infundibular, superior lip from geniculum to distal edge of corolla, flaring to 1.0 cm long, apically recurved forming an ovate or obovate standard, 3.0–6.0(8.0) mm wide, patterned with very fine, linear, often trellised, reddish purple markings, throat white; lower lip tripartite with a few reddish purple spots, often streaked with pink, base with 2 knobby interior protrusions, which serve as channel for style, middle lobe of lower lip recurved. Stamens four, inserted at the same level within the corolla, each filament slender and terminating in a widened connective. Pollen sacs pale lavender turning purplish rose upon drying with two or three rows of minute abundant, sparkling glands adaxially and abaxially. Sterile spur appendages 0.4–0.8(1.5) mm long, smooth, slender, with forked tip of 3–5 cells visible under 10-mm lens. Pistil with slender, hirtellous style and bifid stigma; ovary four-segmented, inserted on a barrel-shaped nectariferous rostrum. Nutlets ovoid, brown, 1.25 mm wide. Chromosome number $n = 16$.

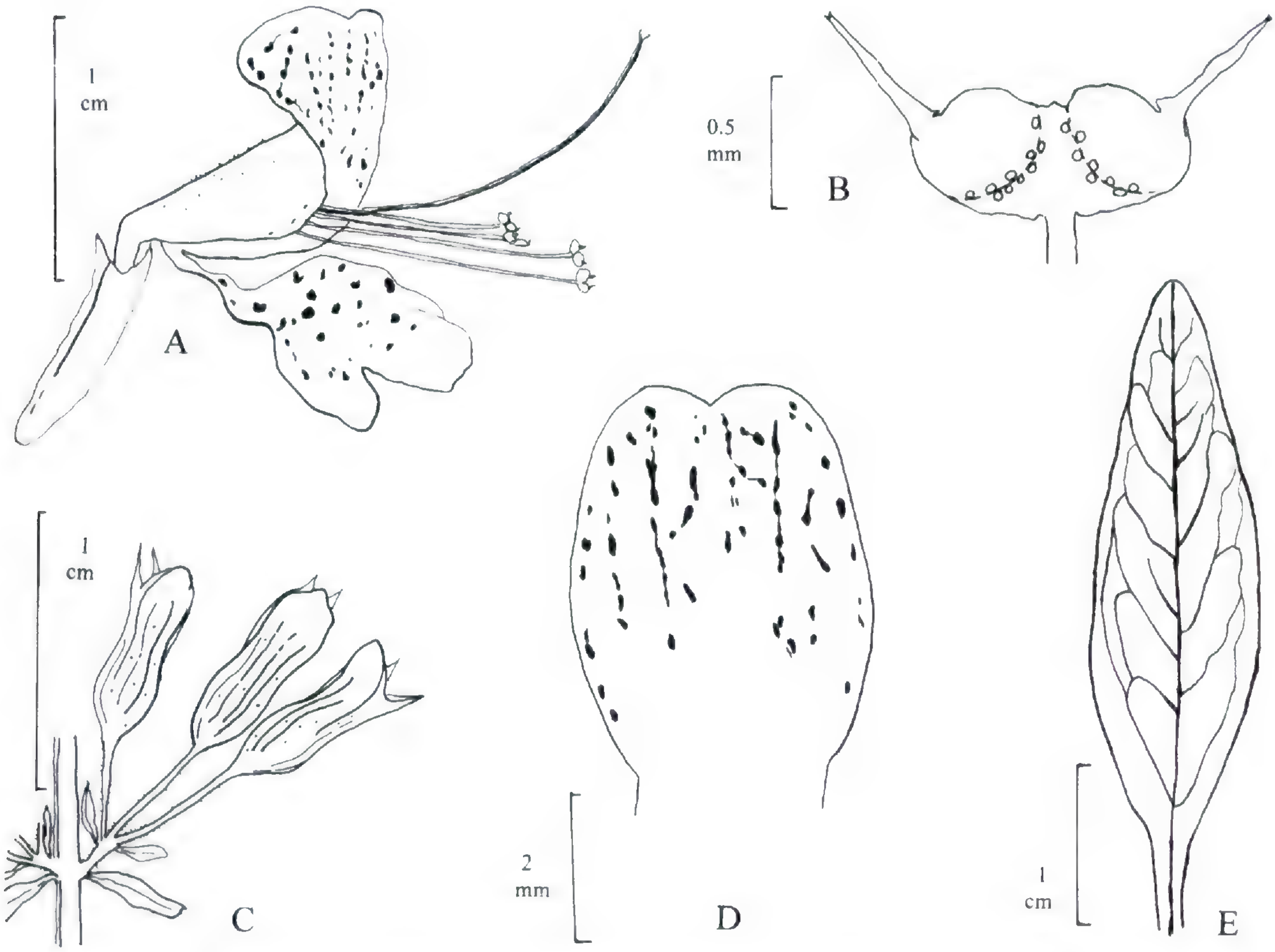


Figure 1. A.–D. *Dicerandra frutescens* Shinners subsp. *modesta* Huck, based on *Huck 5555*.—A. Lateral view of flower. —B. Anther showing dehiscence features at base of anther spurs and glands lining pollen sacs. —C. Cyme with three calyces. —D. Corolla superior lip showing pattern of spotting and trellised lines. —E. *Dicerandra immaculata* Lakela var. *savannarum* Huck, based on *Huck 5492*, leaf at mid stem. Drawing by the author.

Paratypes. U.S.A. **Florida:** Polk Co., Windward Palm Road, N of Sebring, 17 Sep. 1994, *R. B. Huck 5142* with *H. L. Chambers* (FLAS); Rocky Point Road off Canal Road, N of Sebring, 17 Sep. 1994, *R. B. Huck 5143* with *H. L. Chambers* (FLAS); Black Rd, E of Dundee, 13 Aug. 1999, *R. B. Huck 5532* (FLAS), 26 Aug. 1999, *R. B. Huck 5537* (FLAS), *R. B. Huck 5538* (FLAS).

Additional specimens examined. U.S.A. **Florida:** Polk Co., along power line right-of-way, W [E] of Davenport, common throughout sand pine scrub, 22 July 1988, *R. P. Wunderlin 10381, K. Delaney & N. Bissett* (USF); Lake Pierce, N of Lake Wales, 23 Aug. 1988, *R. P. Wunderlin 10384, K. Delaney & E. Menges* (USF); sand pine scrub at western edge of Reedy Creek Swamp near mouth of Horse Creek, E of Davenport, Reedy Creek Scrub, elevation 95–105 ft., 12 Nov. 1990, *S. L. Orzell & E. L. Bridges 15854* (USF).

Distribution. Endemic to Polk County, on the eastern escarpment of the Lake Wales Ridge, peninsular Florida, in disturbed sclerophyllous scrub oak habitat, usually with sand pine (*Pinus clausa* (Chapman ex Engelmann) Vasey ex Sargent). Several listed endemic species are found on the type locality: big-flowered paw paw (*Asimina obovata* (Willdenow) Nash), scrub hickory (*Carya floridana* Sargent), and Garberia (*Garberia heterophylla* (W. Bartram) Merrill & F. Harper).

Distribution of *D. frutescens* subsp. *modesta*, blushing scrub balm, follows the classic pattern of other perennial Dicerandra taxa found on isolated habitat islands of disturbed, excessively drained, sandy soils in Florida. In this case, this new taxon is found on an archipelago of knolls at elevations of 30 m or more within the swamplands and lakes paralleling the eastern edge of the Lake Wales Ridge. Like other perennial Dicerandras in the Lake Wales flora, this new taxon is under pressure from a local construction boom and an expansive citrus industry. Two populations of *D. frutescens* subsp. *modesta* first shown to me by N. Bisset and K. Delaney in 1994 number 10 individuals; however, populations near Lake Pierce and another 8 km north near Davenport total about 500–1000 individuals each.

Dicerandra frutescens subsp. *modesta* differs from subspecies *frutescens* in flower number in a cyme, corolla coloration, upper lip shape of the co-

rolla, and chromosome number (Fig. 1). The epithet *modesta,* meaning "with a sense of modesty, shy," has been chosen to characterize distinctive color change stages in the corolla. Flowers are yellow-cream in the early morning, turn pink or pinkish white in the afternoon, and then blush to darker pink with age when the style is fully extended and the bifid style is open. Plants bloom exuberantly from the end of August to the end of September, often with 2–3 flowers open on each opposing cyme, a different dichasial inflorescence type (see Kral, 1982) as compared with *D. frutescens* subsp. *frutescens* with usually 1–2 flowers on opposing cymes. The latter taxon appears few-flowered, as one or two flowers appear at a time, and all buds may not reach maturity (see Kral, 1982). The corolla of subspecies *modesta* is more delicate than the corolla of subspecies *frutescens.* In *Dicerandra* sect. *Dicerandra* the upper lip of the corolla is bent upward to form a "standard," and in the new taxon this standard is generally ovate or obovate (3.0–8.0 mm in width) in contrast to the oblong or ligulate standard of *D. frutescens* subsp. *frutescens* (3.0–10 mm in width). Anther spur length of the new subspecies is similar and variable from 0.4 to 1.5 mm as compared with subspecies *frutescens* at 0.4 to 0.9 mm, and spur structure and vestiture of these two subspecies appear similar under a 10× lens in the field. Except for the presence of black carpenter bees (*Xylocopa micans*), the list of faunal pollinators of this new subspecies is the same as that of *D. frutescens* subsp. *frutescens,* with beeflies (*Exoprosopa fasciata*) dominant (Huck, 1987).

Dicerandra frutescens subsp. *modesta* as a tetraploid ($n = 16$) and subspecies *frutescens* as a hexaploid ($n = 24$) (Huck & Chambers, 1997) are geographically and apparently reproductively isolated. When compared with the distinctive species *D. cornutissima* Huck and *D. christmanii* Huck & Judd found on the north to south 180-mi.-long ridge system or "spine" of interior peninsular Florida (see White, 1970), *D. frutescens* subsp. *modesta* is appropriately recognized at the level of subspecies. The key to four *Dicerandra* taxa of this Trail-Lake Wales Ridge region revised from Huck et al (1989) follows:

1a. Corolla reddish purple to pinkish coral, style with a few hairs or glabrous; anther spurs over 1 mm long; leaves about 1 mm wide . . . . *D. cornutissima*
1b. Corolla white, cream-colored, or pink; style with abundant stiff hairs; anther spurs less than 1 mm; leaves usually more than 1 mm wide.
  2a. Anthers bright yellow with glands on connective lacking or few; leaves with eucalyptus oil odor . . . . . *D. christmanii*
  2b. Anthers pale purple or occasionally white, with glands on connective abundant; leaves with a minty odor.
    3a. Plant aspect few-flowered; inflorescence with 1–2 flowers per cyme with some buds unopened; corolla white or rarely pink and dense; corolla standard oblong or ligulate *D. frutescens* subsp. *frutescens*
    3b. Plant aspect many-flowered; inflorescence with 2–3 flowers or more per cyme with buds opening successively; corolla pinkish white turning pink with age and delicate; corolla standard ovate or obovate . . *D. frutescens* subsp. *modesta*

2. Dicerandra immaculata Lakela var. **savannarum** Huck, var. nov. TYPE: U.S.A. Florida: St. Lucie County, Netherby Road, off Indian River Drive, Savannas State Preserve, near railroad tracks, 26 Oct. 1996, *R. B. Huck 5492* (holotype, FLAS; isotype, MO). Figure 1E.

Haec varietas a *Dicerandra immaculata* Lakela var. *immaculata* foliis latioribus distinguitur.

Suffruticose chamaephyte to 0.5 m tall with decumbent, overwintering branches arising from a woody base and often rooting at nodes. Leaves epetiolate and rhombic, 1.2–12.0 mm in width and 1.0–40.0 mm in length (averaging 25.0 mm) and leaf margins entire. Inflorescence a verticillaster with 2–3 flowers per cyme, developing in opposing axils. Buds and opening corolla fleshy pink turning to vivid pink at full anthesis. Corolla two-parted with both upper and lower lobes usually lacking spots and lines, immaculate. Corolla tube smoothly bent, not geniculate. Stamens four and pollen sacs pale lavender and lined with minute glands. Sterile spur appendages narrowly pyramidal, ca. 1 mm in length, densely pubescent.

A large-leaved variety, *Diceranda immaculata* var. *savannarum* is endemic to extreme southern St. Lucie County, Florida, near the Martin County line and is allopatric with *D. immaculata* var. *immaculata* found 25 km to the north. The new taxon is distinguished by a lax habit, with decumbent stems rooting at the nodes, rhombic leaves 1.2–12.0 mm in width and 1.0–40.0 mm in length (averaging 25.0 mm), and a fluorescent-pink corolla with an immaculate standard and hairy anther spurs. Rare flowers have red-purple markings on upper lips or standards and spotted lower lips. In comparison, *D. immaculata* var. *immaculata* has a general upright habit, narrowly oblanceolate leaves 1.5–4.0 mm in width and 10.0–22.0 mm in length, and similar floral features. *Dicerandra immaculata* f. *nivea* is an important white-petaled form collected at the site of the holotype for the species (Lakela, 1963) and documents the diversity once present in this highly

endangered taxon. Collected buds of variety *savannarum* were too mature for chromosomes to be counted by H. L. Chambers, USDA-ARS National Clonal Germplasm Repository, Corvallis, Oregon.

Occurrence on sandy, well-drained soils of ridge systems, isolation on island-like habitats adjacent to lower, often wetter, topographic features, and disturbance factors are common patterns for *Dicerandra* species and are present for this new variety as well. *Dicerandra immaculata* var. *savannarum*, Dicerandra of the Savannas, derives the varietal epithet from the relictual interdunal swale feature parallel to the Atlantic Coastal Ridge (sensu White, 1970) on which this new taxon is found. In this particular case, a railway follows the north-south ridge system down the east coast of Florida, adding factors of continued disturbance to the site. Two populations of some 200 individuals have been discovered, with one population protected at Savannas State Park.

Paratypes. U.S.A. **Florida:** St. Lucie, Fort Pierce, Eden Creek Lane, off Indian River Dr., 26 Oct. 1996, *R. B. Huck 5491* (FLAS), 26 Dec. 1996, *R. B. Huck 5498* (USF).

Acknowledgments. This manuscript is prerequisite to treatment of *Dicerandra* for the *Flora of North America*. I am indebted to K. Bradley and G. Gann for bringing populations of *D. immaculata* var. *savannarum* to my attention. I thank T. Race, J. Bennet, and D. L. Black of Lake Wales, Florida, for helping me and providing access to private property and for other courtesies. I thank the Florida Department of Agriculture and Consumer Services Division of Plant Industry for bee identification. I express my gratitude to K. Perkins, Collections Manager, and N. H. Williams, Keeper of the Herbarium, University of Florida, for their continuing generosity and support. I thank the reviewers of *Novon* for their insights and suggestions.

Literature Cited

Huck, R. B. 1987. Systematics and Evolution of *Dicerandra* (Labiatae). Phanerog. Monogr. 19.

———. 1992. Overview of pollination biology in the Lamiaceae. Pp. 167–181 *in* R. M. Harley & T. Reynolds (editors), Advances in Labiate Science. Royal Botanic Gardens, Kew.

——— & H. L. Chambers. 1997. Polyploidy: A factor in the evolution of *Dicerandra* Benth. (Labiatae). Edinburgh J. Bot. 54: 217–229.

———, W. S. Judd, W. M. Whitten, J. D. Skean, R. P. Wunderlin & K. R. Delaney. 1989. A new *Dicerandra* (Labiatae) from the Lake Wales Ridge of Florida, with a cladistic analysis and discussion of endemism. Syst. Bot. 14: 197–213.

Kral, R. 1982. Some notes on *Dicerandra* (Lamiaceae). Sida 9: 238–262.

Lakela, O. 1963. *Dicerandra immaculata* Lakela, sp. nov. (Labiatae). Sida 1: 184–185.

Shinners, L. H. 1962. Synopsis of *Dicerandra* (Labiatae). Sida 1: 89–91.

White, W. A. 1970. The Geomorphology of the Florida Peninsula. Bulletin Number 51, Florida Dept. of Natural Resources, Tallahassee, Florida.

Wunderlin, R. P 1998. Guide to the Vascular Plants of Florida. Univ. Presses Florida, Gainesville, Florida.

New Boraginaceae from Tropical America 4: Three New Species of *Cordia* from South America

James S. Miller
Missouri Botanical Garden, P. O. Box 299, St. Louis, Missouri 63166–0299, U.S.A.

ABSTRACT. Review of specimens newly collected for one of the International Cooperative Biodiversity Groups led to the recognition of three new species closely related to *Cordia trachyphylla* Martius, with which some specimens had previously been confused. All three are members of a group of species within *Cordia* sect. *Myxa* that are characterized by having a costate calyx. Three new species within this group are described, *Cordia hatschbachii, C. kingstoniana,* and *C. koemarae,* and a key is provided to assist in separation of the neotropical species of *Cordia* sect. *Myxa* with costate calyces.

Key words: Boraginaceae, *Cordia,* South America.

Cordia L. is the largest genus in the Boraginaceae with approximately 325 species that occur widely in tropical and subtropical parts of the world; the greatest number of species are restricted to the Neotropics. Most modern authors have recognized six sections in the genus *Cordia* (Taroda & Gibbs, 1986; Nowicke & Miller, 1990). Despite numerous suggestions that several of the morphologically diverse sections of the genus be recognized as separate genera (Nowicke & Ridgway, 1975), most modern authors have continued to treat the genus in a broad sense.

All six currently recognized sections of *Cordia* have all or most of their species in the New World. Sections *Gerascanthus* (Browne) G. Don, *Rhabdocalyx* A. DC., *Superbiflorae* Taroda, and *Varronia* (Browne) G. Don are all restricted to the New World. Species of *Cordia* sect. *Cordia* are mostly Caribbean, with an additional species in Somalia and one more widespread on beaches of the Indian and Pacific Oceans. By far the largest of the sections is *Cordia* sect. *Myxa* (Endlicher) DC., with close to 200 species, and it is the only section well represented in all regions of the tropics. The majority of the species occur in the Neotropics, but about 50 species occur in Africa and Madagascar, and perhaps 20 are known from tropical Asia. The section is difficult taxonomically and has not been treated in a comprehensive manner for the New World since de Candolle (1845), although species have been covered in regional accounts (Johnston, 1930, 1935; Miller, 1988, 2001; Taroda & Gibbs, 1987). In particular, the South American taxa remain poorly known, and their morphological similarity makes it difficult to recognize coherent, manageable species groups. Many species in the section remain undescribed, particularly where the highest diversity occurs in northwestern South America. Recent novelties include the following three new species.

The three species described below all share a costate calyx and a decidedly acuminate leaf apex and are probably related to *Cordia trachyphylla* Martius. Although this name has been associated with specimens over a wide geographic range, recent review of available specimens indicates that Johnston's (1930) circumscription of a plant with ovate to elliptic-ovate leaves less than 16 cm long and 7 cm wide and with an acumen less than 1 cm long and restricted to Bahia was probably correct, and collections from other regions are best assigned to the following species.

Cordia koemarae J. S. Miller, sp. nov. TYPE: Suriname. Sipaliwini: vicinity of the Ulemari River, 99 km upstream from its confluence with Litani River, low primary forest near river, elev. 150 m, 2°58′18″N, 54°33′14″W, 14 Apr. 1998, *B. Hammel, S. Koemar & U. Raghoenandan 21493* (holotype, MO 04974007; isotypes, BBS, US). Figure 1.

Arbor ad 8 m alta, ramunculis sparse pilosis, trichomatis 2–2.5 mm longis. Folia persistentia; laminae anisophyllae, foliis majoribus ellipticis, 12–23.5 cm longis, 6–13 cm latis, minoribus orbicularis, ca. 8.5 cm longis, 7.5 cm latis, apice acuminato et caudato, acuminibus 1.5–2 cm longis, basi rotundata ad obtusam, margine integra, supra sericea, trichomatis 2.5–4 mm longis, appressis, pagina inferiore sericea ad pilosam, trichomatis 2–3 mm longis; petioli 4–7 mm longi. Inflorescentia terminalis vel axillaris, cymosa, 8–10 cm latis. Flores bisexuales; calyx tubularis, ca. 6 mm longus, 10-costatus; corolla alba, tubularis, 5-lobata; stamina 5, filis 8–10 mm longis, pubescentia ad insertionem.

Tree 8 m tall, the twigs sparsely but evenly pilose, the hairs 2–2.5 mm long, yellow-brown. Leaves persistent, dimorphic, larger leaf blades el-

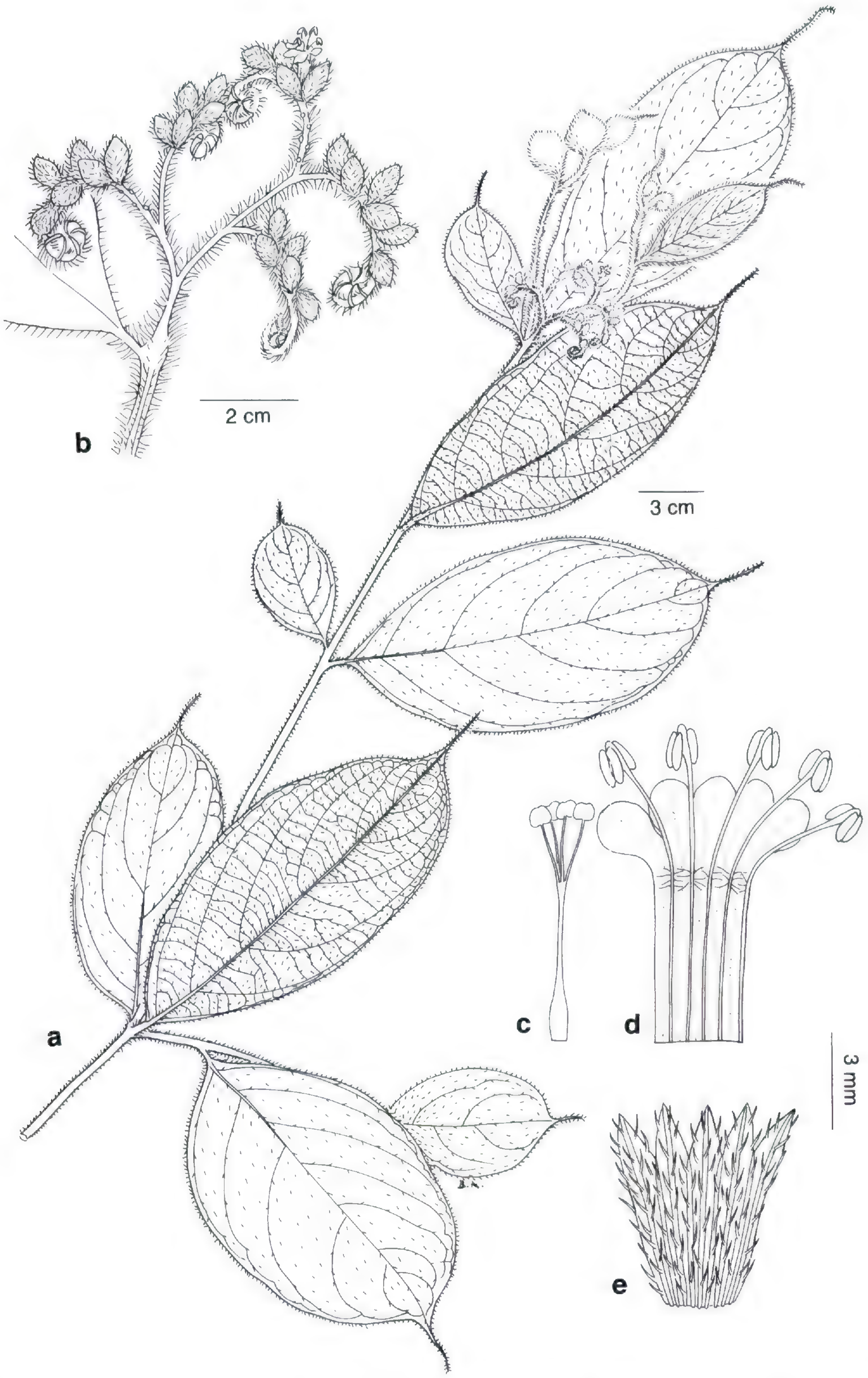


Figure 1. *Cordia koemarae* J. S. Miller. —a. Flowering branch. —b. Inflorescence. —c. Gynoecium. —d. Corolla opened to show insertion of stamens. —e. External surface of opened calyx. (All from *Hammel et al. 21493*, MO, holotype.)

liptic, 12–23.5 cm long, 6–13 cm wide, the apex abruptly acuminate, then caudate, the thin, hair-like acumen 1.5–2 cm long, the base rounded to obtuse, sometimes slightly unevenly so, the margin entire, the adaxial surface densely sericeous on young leaves, sparsely sericeous on mature leaves, the hairs tightly appressed, 2.5–4 mm long, the abaxial surface evenly sericeous to pilose, the hairs spreading, 2–3 mm long, the venation brochidodromous, the midrib slightly elevated, the secondary veins 6 or 7, connected by a series of nearly parallel tertiary veins, the dimorphic leaves borne opposed to larger leaves in branch axils, smaller, orbicular, ca. 8.5 cm long, 7.5 cm wide, petioles 4–7 mm long, canaliculate on the adaxial surface, pilose, the hairs ca. 3 mm long. Inflorescences terminal or borne in the axils of branches, cymose, 8–10 cm broad, the branches pilose, the hairs 2–3 mm long. Flowers bisexual; calyx narrowly tubular, ca. 6 mm long, 3 mm wide at the mouth, 10-costate, pilose, the hairs spreading, 1.5–2 mm long; corolla white, tubular with spreading lobes, ca. 8 mm long, the 5 lobes ovate, ca. 2 mm long, 1.5 mm wide; stamens 5, strongly exserted, the filaments 8–10 mm long, the upper 4–5 mm free, pubescent at the point of insertion, the anthers bilobed, a round gland present apically between the anther sacs; ovary ovoid, ca. 1 mm long, 0.5 mm wide, glabrous, the style ca. 3 mm long, the stigmas capitate. Fruits unknown.

Distribution. *Cordia koemarae* is known only from the type collection made in the southeastern corner of Suriname near the border with French Guiana.

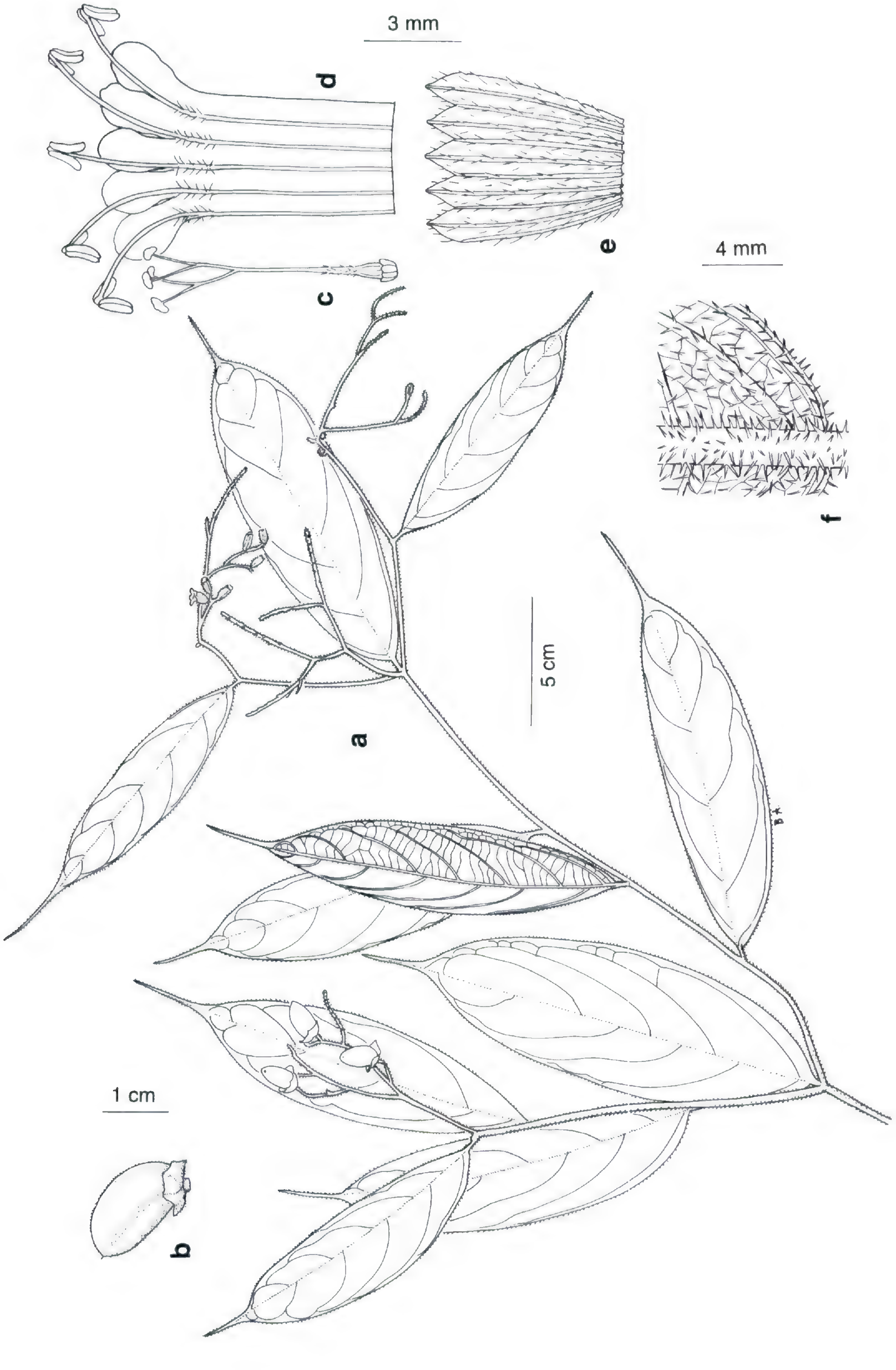
Cordia koemarae is a distinctive species in its pilose indument, caudate leaf apex with a hair-like acumen about 2 cm long, and its 10-costate calyx. Many species of *Cordia* sect. *Myxa* have two opposing leaves borne from each branch axil, one of which is decidedly smaller and different in shape (frequently orbicular) from the other larger leaves. This appears to be the case with *C. koemarae*, although the duplicates of the single known collection show only a single smaller orbicular leaf. The flowers of the single known collection do have both stamens and an apparently normal gynoecium indicating that this species most probably has bisexual flowers, as opposed to the dioecy that characterizes the Central American species with costate calyces.

Cordia koemarae was identified from material collected in southeastern Suriname during review of specimens collected for the Suriname International Cooperative Biodiversity Group (ICBG). The Suriname ICBG is a multi-institutional partnership with the three main goals of natural products drug discovery, economic development, and conservation. Fieldwork is conducted by members of the Missouri Botanical Garden and Conservation International in collaboration with staff of the National Herbarium of Suriname to collect bulk plant material for pharmaceutical evaluation and support biological inventory that contributes to conservation initiatives in Suriname. *Cordia koemerae* is named in honor of Sylva Koemar, who has helped to organize and conduct many of the field expeditions for the ICBG project and whose tireless efforts in the field have helped with the collection of many specimens that have added to our knowledge of the flora of Suriname, including the type of this new species.

Cordia kingstoniana J. S. Miller, sp. nov. TYPE: Peru. Loreto: Prov. Requena, Jenaro Herrera, elev. ca. 170 m, 4°50′S, 73°45′W, 3 July 1981, *R. Vásquez, K. Young & N. Jaramillo 2143* (holotype, MO 3314002). Figure 2.

Frutex vel arbor parva ad 3(–12) m alta, ramunculis hirsutis ad strigillosos. Folia persistentia, homomorpha; lamina anguste elliptica ad leviter oblanceolatam vel lanceolatam, (9–)10.5–18(–23) cm longa, (2.5–)3–7(– 10.5) cm lata, apice acuminato, acuminibus (0.8–)1.5–3 cm longis, basi rotundata ad acutam, margine integra, supra glabra, pagina inferiore strigosa; petioli 1–5(–10) mm longi. Inflorescentia terminalis et axillaris, 5–10(–15) cm latis. Flores bisexuales; calyx tubularis, 5–6.5 mm longus, leviter 10-costatus, sparse strigillosus ad hirsutum; corolla alba, tubularis, 5–7 mm longa, 5-lobata; stamina 5, filis 10–12 mm longis, pubescentia ad insertionem. Fructus drupaceus, albus, putamine inequilateraliter ellipsoideo, 1.3–1.8 cm longo, 0.8–1.1 cm lato.

Shrub or small tree to 3(–12) m tall, the stems hirsute or less commonly strigillose, the hairs 0.5–1 mm long. Leaves persistent, homomorphic; leaf blades narrowly elliptic to slightly oblanceolate or lanceolate, (9–)10.5–18(–23) cm long, (2.5–)3–7(–10.5) cm wide, the apex acuminate, the acumen (0.8–)1.5–3 cm long, the base rounded to acute, the margin entire, the adaxial surface glabrous, strigose on the midrib, the abaxial surface strigose, the venation brochidodromous, the midrib distinct and elevated on both surfaces, the secondary veins 6 to 8(–9); petioles 1–5(–10) mm long, flattened, rounded, or shallowly canaliculate on the adaxial surface, stiffly pubescent to hirsute, the hairs silaceous. Inflorescences terminal and in the axils of leaves and branches, 5–10(–15) cm broad, the branches hirsute, the hairs 0.5–1 mm long. Flowers bisexual; calyx tubular, 5–6.5 mm long, 2–3 mm wide at the mouth, lightly 10-costate, sparsely strigillose to hir-


3 mm
d
e
4 mm
c
f
5 cm
a
1 cm
b

sute, the hairs ca. 0.5 mm long, unevenly 3- to 5-lobed, the lobes widely triangular to ovate, 1–1.3 mm long; corolla white, tubular with reflexed lobes, 5–7 mm long, 5-lobed, the lobes obovate, 2–3 mm long, 1.5–1.8 mm wide; stamens 5, strongly exserted, the filaments 10–12 mm long, the upper 5–6 mm free, pubescent at the point of insertion, the anthers 1–1.5 mm long; ovary ovoid, 1–1.5 mm long, 0.6–0.8 mm wide, glabrous, the style 6–9 mm long, glabrous or with a few appressed hairs along the base, the stigmas capitate. Fruits drupaceous, white, subtended by the slightly expanded, cupulate calyx, the exocarp evidently strigillose to nearly glabrous, endocarp asymmetrically ellipsoid, 1.3–1.8 cm long, 0.8–1.1 cm broad.

Distribution. *Cordia kingstoniana* is widespread in western Amazonia in Peru, Ecuador, and adjacent Brazil, and it should be expected in southeastern Colombia.

This is a relatively widespread species known from a significant number of collections. This distinctive species is remarkably constant in appearance and can easily be recognized by its slender twigs and short-petioled narrowly elliptic leaves that are prominently acuminate. *Romoleroux & Foster 2015* and *Asunción 118* are unusual among collections of this new species in their large leaves. The name *Cordia trachyphylla* has been applied to specimens of *C. kingstoniana*, but leaves of the two species are quite distinct. *Cordia kingstoniana* has narrowly elliptic to slightly oblanceolate or lanceolate leaves that are close to parallel sided and have an acumen usually more than 1.5 cm long, while *C. trachyphylla* has more ovate leaves, definitely not parallel sided, and with an acumen less than 1 cm long.

This species is named in honor of David G. I. Kingston of Virginia Polytechnic Institute and State University who has contributed greatly to our knowledge of the medicinal value of plant-derived compounds, particularly those used to treat cancer. Prof. Kingston is the group leader and coordinates the ICBG project.

Additional specimens examined. BRAZIL. **Amazonas:** São Paulo de Olivença, *Mori et al. 9182* (MO). **Pará:** Mun. de Itaituba, estrada Santarém–Cuiabá, BR 163, Km 1229, *Silva 385* (MO). **Rondônia:** vicinity of Santa Barbara, 15 km E of Km 117, *Prance & Ramos 7181* (MO); Porto Velho, Represa Samuel, forest along PR-3 road, ca. 10 km SE of dam, 8°49′S, 63°24′W, *Thomas et al. 5133* (MO). ECUADOR. **Napo:** Orellana, Parque Nacional Yasuní, carretera y oleoductuo de Maxus en construcción, Km 54–58, elev. 250 m, 0°48′S, 76°30′W, *Aulestia & Andi 714* (MO); Estación Científica Yasuní, Parcela de 50 ha, elev. 200–300 m, 0°38′S, 76°30′W, *Romoleroux & Grefa 1835* (MO), *2015* (MO). PERU. **Amazonas:** Monte Virgin, 1 km de bajo de La Poza, Río Santiago, elev. 180 m, *Asunción 118* (MO); Monte Virgin, 2 km abajo de la communidad de Caterpiza, trocha de Mitayar, banda oeste de la Quebrada Caterpiza, Río Santiago, *Huashikat 610* (MO). **Loreto:** Prov. Maynas, Caserio de Huanta, Río Orosa, a 5 minutos de la boca, margen izquierda una hora de camino, monte alto, elev. 120 m, *Díaz et al. 476* (MO); Prov. Maynas, Yanamono, Explorama Tourist Camp on Río Amazonas between Indiana and mouth of Río Napo, elev. 120 m, 3°28′S, 72°48′W, *Gentry et al. 29129* (MO-2); Prov. Alto Amazonas, Andoas, Río Pastaza near Ecuador border, elev. 210 m, 2°48′S, 76°28′W, *Gentry et al. 29783* (MO); Prov. Maynas, Iquitos, Estación Biológica Allpahuayo, elev. 130 m, 3°53′S, 73°25′W, *Jaramillo & Marcos 709* (MO); Prov. Maynas, Distrito Pebas, Río Ampiyacu, cerca a estación IMARPE, 1 km antes de Quistocha, *Revilla 936* (MO); Prov. Maynas, Distrito Iquitos, Río Nanay, carretera del Caserio de Lupuna to Santa Clotilde, in front of Bella Vista, *Rimachi 1786* (MO); Prov. Maynas, Distrito Iquitos, Río Nanay near mouth, carretera de Picuruyacu, trocha del fundo "Monte Azul", elev. ca. 160 m, *Rimachi 6633* (MO); Prov. Maynas, Distrito Iquitos, carretera del caserio de Puerto Almendras, monte alto, arcilloso, cerca al terreno de la UNAP, elev. ca. 140 m, *Rimachi 6948* (MO); Prov. Maynas, Puerto Almendras, elev. 122 m, 3°48′S, 73°25′W, *Vásquez & Jaramillo 4238* (MO); Prov. Maynas, Indiana, Explorama Reserve, elev. 108 m, 3°30′S, 73°05′W, *Vásquez et al. 13449* (MO); Prov. Maynas, Iquitos, Allpahuayo, Estación Experimental del Instituto de Investigaciones de la Amazonia Peruana (IIAP), *Vásquez et al. 13869* (MO), *Vásquez & Jaramillo 14066* (MO), *Vásquez et al. 16239* (MO), *Vásquez 16713* (MO), *Vásquez et al. 23544* (MO).

Cordia hatschbachii J. S. Miller, sp. nov. TYPE: Brazil. Espírito Santo: Mun. Linhares, Reserva Flora da Sooretama, Rod. BR-101, 8 Apr. 1984, *G. Hatschbach 47742* (holotype, MO 3648229; isotypes, MBM, MO). Figure 3.

Frutex 2 m alta, ramunculis pubescentibus. Folia persistentia; lamina oblanceolata ad anguste ellipticam, 14.5–30 cm longa, 3.8–6.3 cm lata, apice acuminato, basi attenuata ad acutam, margine integra et leviter revoluta, supra scabra, pagina inferiore pubescenti; petioli 4–6 mm longi. Inflorescentia terminalis, cymosa, 6–9.5 cm lata. Flores bisexuales; calyx tubularis, 5–5.5 mm longus, 10-costatus; corolla alba, tubularis, 6.5–8 mm longa, 5-lobata; stamina 5, filis ca. 8.5 mm longis, pubescentia ad insertionem.

Shrub 2 m tall, the stems stiffly pubescent, the hairs spreading, 0.5–1 mm long. Leaves persistent;

←

Figure 2. *Cordia kingstoniana* J. S. Miller. —a. Flowering branch. —b. Fruit asymmetrical in persistent calyx. —c. Gynoecium. —d. Corolla opened to show insertion of stamens. —e. External surface of opened calyx. —f. Lower surface of leaf base. (All from *Vásquez et al. 2143*, MO, holotype.)

Figure 3. *Cordia hatschbachii* J. S. Miller. —a. Flowering branch. —b. External surface of opened calyx. —c. Gynoecium. —d. Corolla opened to show insertion of stamens. (All from *Hatschbach 47742,* MO, holotype.)

leaf blade oblanceolate to narrowly elliptic, the broadest point above the middle, 14.5–30 cm long, 3.8–6.3 cm wide, the apex acuminate, the base attenuate to acute, the margin entire and slightly revolute, the adaxial surface scabrous, very rough to the touch, coarsely and stiffly pubescent along the primary and secondary veins, the abaxial surface stiffly pubescent, densely so on the primary and secondary veins, venation brochidodromous, the midrib slightly elevated above, distinct and terete below, coarsely pubescent on both surfaces, the secondary veins 8 to 12; petioles 4–6 mm long, canaliculate above, coarsely pubescent. Inflorescences terminal, cymose, 6–9.5 cm broad, coarsely pubescent, the peduncles 0.8–5.5 cm long. Flowers bisexual; calyx tubular, 5–5.5 mm long, 1.5–2 mm wide at the mouth, 10-costate, densely pubescent, 5-lobed, the lobes triangular, ca. 1 mm long; corolla white, tubular, 6.5–8 mm long, 5-lobed, the lobes spreading to reflexed, ovate, ca. 2.5 mm long, 1.8 mm wide; stamens 5, the filaments ca. 8.5 mm long, the upper 4 mm free, pubescent at the point of insertion, the anthers ca. 1.5 mm long; ovary ovoid, ca. 1.5 mm long, 1 mm wide, glabrous, the style ca. 5 mm long, the stigmas capitate. Young fruits drupaceous, subtended by the calyx, the exocarp minutely strigillose, mature fruits unknown.

Distribution. *Cordia hatschbachii* is known only from the type collection from Atlantic coastal forests in Espírito Santo.

This species is quite distinctive in its long (14.5–30 cm) narrowly oblanceolate leaf blades that are somewhat clustered near the ends of branches. This species is named in honor of Gert Hatschbach, from the Museu Botânico Municipal in Curitiba, Brazil, whose collections and research have contributed so much to our knowledge of the forests of coastal Brazil. The type collection is one of many invaluable collections that he has made documenting the diversity and conservation importance of this highly threatened region so rich in endemic species.

Cordia sect. *Myxa* is a large, diverse group, and recognition of groups of related species within the section has proven difficult. One character that is very distinctive in the section, is easily visible on specimens, and occurs in only a limited number of species is the presence of a costate calyx. This character facilitates species recognition but most probably does not circumscribe a monophyletic group. The four species with costate calyces in Central America (*C. cordiformis* I. M. Johnston, *C. diversifolia* A. DC., *C. salavadorensis* Standley, and *C. skutchii* I. M. Johnston) are probably closely related, as they also share serrate leaf margins and dioecy. However, the South American *C. trachyphylla*, *C. trichoclada* DC., *C. chamissoniana* Don, *C. gardneri* I. M. Johnston, *C. sipapoi* Gaviria, *C. decipiens* I. M. Johnston, and the three new species described here are quite diverse morphologically, may not be a monophyletic group, and are probably a different lineage from the species with costate calyces in Central America. Yet costate calyces is an easily observable character useful for recognition of species, so the key presented below is for purposes of identification and is not meant to convey any sense of relationship.

Key to the Neotropical Species of *Cordia* sect. *Myxa* with Costate Calyces

1a. Leaf margins serrate to minutely denticulate; Central America and Mexico.
  2a. Leaf base acute, obtuse, or rounded.
    3a. Leaves at least 3 times as long as wide; stigma lobes clavate; calyx 3.7–6.5 mm long.
      4a. Upper leaf surface evenly strigose; corolla 7.5–10.5 mm long; southern Mexico to Panama . . . . . *C. diversifolia*
      4b. Upper leaf surface glabrous to scabrous; corolla 5.8–6.5 mm long; Guatemala . . . . *C. skutchii*
    3b. Leaves usually less than 3 times as long as wide; stigma lobes filiform; calyx 3–4 mm long; Mexico to Nicaragua . . . . . *C. salvadorensis*
  2b. Leaf base cordate; Mexico to Guatemala . . . . . *C. cordiformis*

1b. Leaf margins entire; South America.
  5a. Leaves greater than 15 cm wide.
    6a. Leaves bullate; southeastern Brazil . . . . . *C. trichoclada*
    6b. Leaves not bullate; Brazil and Peru . . . . . *C. chamissoniana*
  5b. Leaves less than 13 cm wide.
    7a. Leaves elliptic or elliptic-ovate, ca. twice as long as wide.
      8a. Stems and leaves pilose, the hairs more than 1 mm long.
        9a. Leaf apex caudate; ovary glabrous; Suriname . . . . . *C. koemarae*
        9b. Leaf apex acute to attenuate; southeastern Brazil . . . . . *C. gardneri*
      8b. Stems and leaves various, the hairs less than 1 mm long.
        10a. Ovary glabrous.
          11a. Leaf base acute; southeastern Brazil . . *C. trachyphylla*
          11b. Leaf base obtuse to rounded; Venezuela . . . . . *C. sipapoi*
        10b. Ovary pubescent; northwestern Brazil *C. decipiens*

7b. Leaves lanceolate to narrowly elliptic or oblanceolate, at least 3 times as long as wide.
12a. Hairs on stems erect; leaf base rounded to acute; Brazil, Ecuador and Peru *C. kingstoniana*
12b. Hairs on stems spreading; leaf base attenuate to acute; southeastern Brazil . . *C. hatschbachii*

Acknowledgments. Financial support for the ICBG project was provided by the National Institutes of Health, the National Science Foundation, and the U.S. Agency for International Development, under Grant No. U01 TW/CA-00313. Joshua Rosenthal, of the Fogarty International Center, NIH, and James Rodman, NSF, have provided tremendous support and encouragement for the ICBG project. I also thank Barbara Alongi for the illustrations.

Literature Cited

Candolle, A.P. de. 1845. Boraginaceae. *In*: Prodromus Systematis Naturalis Regni Vegetabilis 9: 466–501.

Johnston, I. M. 1930. Studies in the Boraginaceae VIII. Observations on the species of *Cordia* and *Tournefortia* known from Brazil, Paraguay, Uruguay, and Argentina. Contr. Gray Herb. 92: 3–89.

———. 1935. Studies in the Boraginaceae X. The Boraginaceae of northeastern South America. J. Arnold Arbor. 16: 1–64.

Miller, J. S. 1988. A revised treatment of Boraginaceae for Panama. Ann. Missouri Bot. Gard. 75: 456–521.

———. 2001. Boraginaceae. *In*: W. D. Stevens, C. Ulloa U., A. Pool & O. M. Montiel (editors), Flora de Nicaragua. Monogr. Syst. Bot. Missouri Bot. Gard. 85. 1: 435–455.

Nowicke, J. W. & J. E. Ridgway. 1975. Pollen studies in the genus *Cordia* (Boraginaceae). Amer. J. Bot. 60: 584–591.

——— & J. S. Miller. 1990. Pollen morphology of the Cordioideae (Boraginaceae): *Auxemma*, *Cordia*, and *Patagonula*. Pl. Syst. Evol. [Suppl. 5]: 103–121.

Taroda, N. & P. E. Gibbs. 1986. Studies on the genus *Cordia* L. (Boraginaceae) in Brazil. 1. A new infrageneric classification and conspectus. Revista Brasil. Bot. 9: 31–42.

——— & ———. 1987. Studies in the genus *Cordia* L. (Boraginaceae) in Brazil. 2. An outline taxonomic revision of subgenus *Myxa* Taroda. Hoehnea 14: 31–52.

Canastra, a New Genus of Paniceae (Poaceae, Panicoideae) Segregated from *Arthropogon*

Osvaldo Morrone, Fernando O. Zuloaga
Instituto de Botánica Darwinion, Casilla de Correo 22, Labardén 200, San Isidro, B1642HYD, Argentina

Gerrit Davidse
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.

Tarciso S. Filgueiras
UPIS-Faculdades Integradas, Campus II–Dept. de Agronomia & Zootecnia, Cx. Postal 10743, Planaltina, DF 73350-980, Brazil

ABSTRACT. Based on morphological, anatomical, and molecular evidence, the Brazilian endemic grass *Arthropogon lanceolatus* is reclassified in the newly described, monotypic genus *Canastra*. *Canastra lanceolata* is illustrated, and the genus is compared with the putatively related taxa in the Paniceae: *Altoparadisium*, *Achlaena*, *Homolepis*, *Streptostachys*, *Panicum* sects. *Laxa*, *Lorea*, and *Prionitia*, and *Cliffordiochloa*.

Key words: Brazil, *Canastra*, Paniceae, Panicoideae, Poaceae.

During a recent revision of *Arthropogon* Nees and the establishment of the new genus *Altoparadisium* Filgueiras, Davidse, Zuloaga & Morrone (Filgueiras et al., 2001), it became evident that *Arthropogon lanceolatus* Filgueiras was erroneously placed within that genus. However, at that time it was not possible to ascertain a clearly defined position within the Paniceae for this taxon. New phylogenetic studies in the tribe, using molecular data of the gene *ndh*F (Giussani et al., in press), together with previous morphological analyses (Zuloaga et al., 2000; Filgueiras et al., 2001) allowed us to establish its relationships within Paniceae more clearly, and we now describe a new genus to place this species.

MATERIALS AND METHODS

Herbarium specimens were examined from IBGE, MO, R, and US. Transverse sections of dried leaf blades were prepared after desilicification in 10% hydrofluoric acid (Breakwell, 1914); the sections were then stained in safranin and fast green. Abaxial epidermal peels of leaf blades were prepared by removing the mesophyll and vascular tissue with a scalpel following the method of Metcalfe (1960). The epidermis was then stained in safranin. The standardized terminology of Ellis (1976, 1979) was used to describe the anatomical structure of the leaves.

Canastra Morrone, Zuloaga, Davidse & Filgueiras, gen. nov. TYPE: *Canastra lanceolata* (Filgueiras) Morrone, Zuloaga, Davidse & Filgueiras.

Spiculae dorsaliter compressae, callus glaber haud pilosus, gluma infera et supera aristatae, gluma infera redacta, 1-nervia, anthoecium superum cartilagineum, quam gluma supera et lemma inferum crassius, lemma superum paleae superae apicem includens, lamina anatomia non-Kranz ("C_3" dicta), mesophyllum cellulis fusiformibus manifestis praeditum. *Homolepis*, *Streptostachys*, *Cliffordiochloa* et *Panicum* sect. *Laxa* spiculis dorsaliter complanatis, callo glabro, cellulis fusiformibus mesophyllo, cellulis distinctis nullis ("Kranz" dictae) similis sed glumis aristatis, anthoecio supero cartilagineo absimilis.

Canastra lanceolata (Filgueiras) Morrone, Zuloaga, Davidse & Filgueiras, comb. nov. Basionym: *Arthropogon lanceolatus* Filgueiras, Bradea 3(36): 307. 1982. TYPE: Brazil. Minas Gerais: Furnas, Ribeirão das Pacas-Cascata, na margem do rio sobre quartzito, 28 July 1966, *Legerunt Luiz Emygdio, Aydil Andrade, Nobre de Melo, E. Lessa & F. Medeiros 2308* (holotype, R-116424; isotypes, IBGE-19804, MO-5102622, US-5102622). Figure 1.

Plants perennial, caespitose. Culms 50–60 cm tall, simple or branched at the basal nodes, erect; internodes compressed, striate, glabrous; nodes glabrous. Sheaths overlapping, longer than the internodes, laterally compressed, keeled on the back,

Figure 1. *Canastra lanceolata* (Filgueiras) Morrone, Zuloaga, Davidse & Filgueiras. —A. Habit. —B. Spikelet, lateral view. —C. Lower and upper anthecia, lateral view. —D. Lower lemma, dorsal view. —E. Lower palea, ventral view. —F. Upper anthecium, lemma view. —G. Upper anthecium, palea view. —H. Upper palea, dorsal view. —I. Upper palea, ventral view, and lodicules. —J. Caryopsis, embryo side. —K. Caryopsis, hilum side. (Based on *Emygdio et al. 2308*, IBGE, isotype.)

ciliate, with papillose-pilose hairs on the lower portion of the membranous margins, otherwise glabrous; lower sheaths usually laciniate. Ligules 1.4–1.6 mm long, membranous-ciliate, the membranous portion ca. 0.2 mm long, the hairs 0.9–1.3 mm long, whitish; collar glabrous. Leaves linear, 15–30 × 0.4–0.7 cm, involute, rigid, narrowed at the base, the apex subulate, densely papillose-pilose on the basal portion near the ligule, glabrous on the rest of the surface, the margin involute, papillose-pilose toward the base. Inflorescences terminal or axillary, borne from the uppermost nodes, many-flowered; peduncle up to 25 cm long, glabrous. Terminal panicle congested, exserted, 10–22 × 2–5 cm; main axis angular, scaberulous to smooth, glabrous; pulvini long-pilose; primary branches alternate to subopposite, the lower ones 4–5 cm long, divergent from the axis; secondary and tertiary branches adpressed, axis of the branches triquetrous, scabrous; pedicels triquetrous, scabrous; axillary panicles partially exserted, 8–10 × 1–2 cm. Spikelets long ellipsoid, 3–3.2 mm long, exclusive of awns, 0.8 mm wide, dorsiventrally compressed, 2-flowered, scabrous, greenish and tinged with purple. Lower glume awned, 0.4–1.2 mm long without the awn, 1-nerved, scabrous, the awn up to 1.7 cm long, scabrous with antrorse hairs, flexuous, purplish. Upper glume as long as the spikelet, awned, herbaceous, 5-nerved, the nerves prominent and scabrous, the awn up to 1.5 cm long, scabrous with antrorse hairs, purplish. Lower lemma 2.7–3 mm long, 3-nerved, acute, glabrous. Lower palea lanceolate, 2–2.2 × 0.5 mm, hyaline, 2-nerved, glabrous, the margins smooth to scaberulous. Lower flower staminate, stamens 3, purplish; anthers 1–1.8 mm long. Upper anthecium long-ellipsoid, acute, cartilaginous, 2.4–2.7 × 0.4 mm, glabrous. Upper lemma not enclosing the apex of the palea, 3-nerved, the nerves not prominent. Upper palea 2-nerved, glabrous. Upper flower bisexual; lodicules 2, ca. 0.2 mm long, hyaline, conduplicate; stamens 3; anthers 1.4–1.6 mm long; styles 2, free from the base; stigmas plumose, purple. Caryopsis long ellipsoid, 1.2 × 0.3 mm, plano-convex; hilum punctate, basal; embryo 1/3–1/2 as long as the caryopsis.

Additional specimens examined. BRAZIL. **Minas Gerais:** Furnas, cerrado próximo às eclusas, pelas estada Belo-Horizonte-Furnas, 6 July 1995, *Lombardi 877* (IBGE, MO); São Roque de Minas, Parque Nacional da Serra da Canastra, 14 July 1997, *Lombardi 1895* (IBGE); nascente do Rio São Francisco, 11 Sep. 1999, *Filgueiras & Rodrigues-da Silva 3588* (IBGE, MO, SI, SP); Casca d'Anta, 11 Sep. 1999, *Filgueiras & Rodrigues-da Silva 3589* (IBGE, MO, SI, SP); Rio das Pedras, 11 Sep. 1999, *Filgueiras & Rodrigues-da Silva 3590* (IBGE, K, ICN); Rio do Peixe, 11 Sep. 1999, *Filgueiras & Rodrigues-da Silva 3591* (B, IBGE, NY, R), 11 Sep. 1999, *Filgueiras & Rodrigues-da Silva 3592* (IBGE, MO, SI, US).

Leaf Blade Anatomy

Histofoliar analyses of this species allowed us to conclude that *Canastra lanceolata* is a C_3, non-Kranz species, characterized by two sheaths around the vascular bundles, the outer parenchymatous sheath without specialized chloroplasts, and an inner mestome sheath, also without specialized chloroplasts. The mesophyll is irregularly radiate, with 8 to 12 cells between consecutive vascular bundles.

This genus is also distinguished by the presence of fusoid cells in the transverse section of the blade. Fusoid cells were previously reported in the tribe Paniceae in *Homolepis* Chase, *Streptostachys* Desvaux, and *Panicum* L. (for a detailed discussion see Zuloaga et al., 1992).

LEAF BLADE IN TRANSVERSE SECTION (FIG. 2)

Outline: V-shaped; leaf thickness at mid-lamina 90–152 μm, arms of the lamina symmetrical. *Ribs and furrows*: adaxial ribs and furrows slightly developed, abaxial ribs and furrows indistinguishable; ribs associated with the vascular bundles, the apex flat; furrows 1/4–1/3 deep in relation to the width of the lamina. *Median vascular bundle*: midrib with a first-order vascular bundle, structurally distinguishable from the lateral first-order vascular bundles, solitary, associated with adaxial colorless parenchyma. *Vascular bundle arrangement*: 14 to 16 vascular bundles in the entire blade; 2 or 3 second-order vascular bundles between contiguous vascular bundles. First-order vascular bundles circular to elliptical in outline; metaxylem vessel elements narrow, with angular walls; phloem tissue adjoining the inner bundle sheath. Second-order vascular bundles elliptical in outline, with xylem and phloem tissue distinguishable; all vascular bundles situated in center of blade; 8 to 12 mesophyll cells between contiguous vascular bundles. *Vascular bundle sheaths*: outer first-order bundle sheaths consisting of 8 to 12 parenchyma cells, with abaxial interruption of sclerenchyma girders; outer second-order bundle sheaths completely surrounding the vascular bundle, with 8 to 10 parenchyma cells; parenchyma sheath cells inflated with thin walls and lacking chloroplasts; mestome bundle sheaths complete, surrounding the xylem and phloem tissue or present with a few cells abaxially in the second-order bundles. *Sclerenchyma*: minute, adaxial and abaxial girders associated with first- and second-order vascular bundles; fiber thick-walled, ligni-

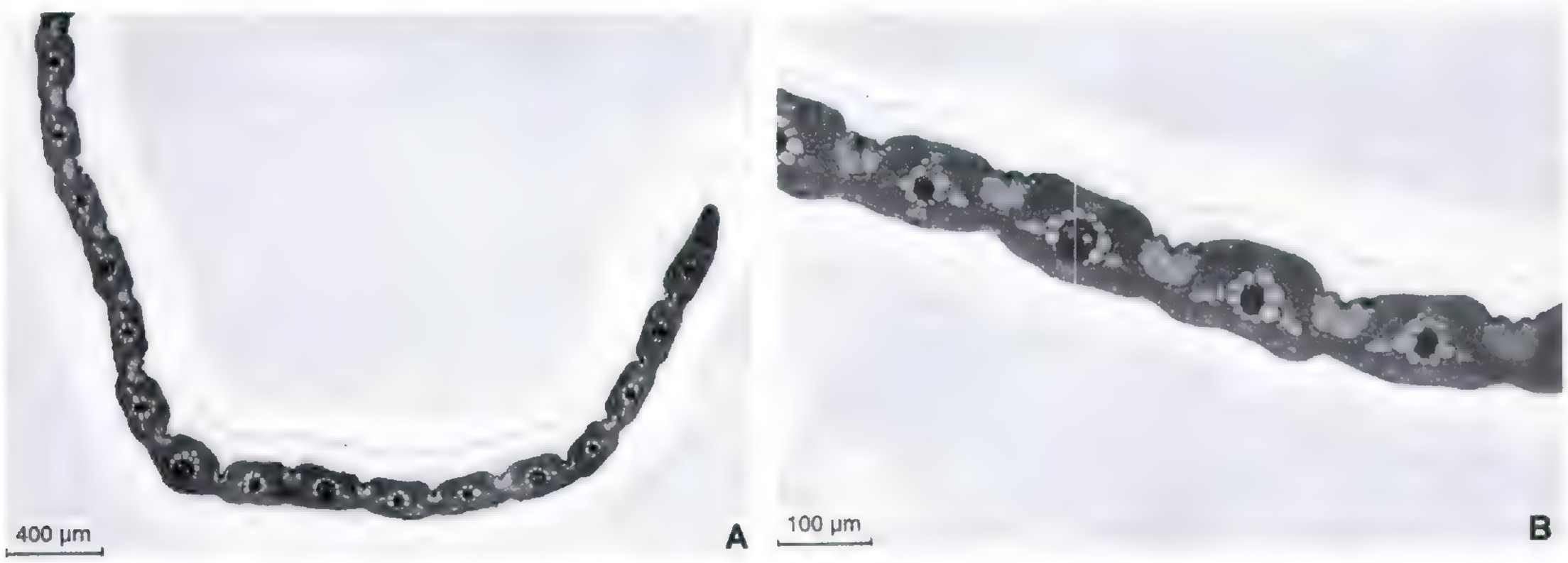


Figure 2. Leaf blade anatomy of *Canastra lanceolata*, transverse sections. —A. Outline of the leaf blade. —B. Detailed view of A showing first-, and second-order vascular bundles, bulliform cells, and fusoid cells. (*Filgueiras & Rodrigues-da Silva 3588*, SI.)

fied. Small sclerenchyma cap present in the margin of the lamina. *Mesophyll*: chlorenchyma irregularly radiate around the vascular bundles; chlorenchyma cells tabular, raquimorphous. Fusoid cells present. *Adaxial epidermal cells*: bulliform cells present in adaxial furrows between all vascular bundles, fan-shaped, in restricted group of 4 to 6 cells, occupying up to 1/2 of the blade thickness. Epidermal cells small, regular in size, the outer walls flattened and with continuous and thickened cuticle. Macrohairs, papillae, and prickles absent. *Abaxial epidermal cells*: bulliform cells absent; cuticle thickened; macrohairs, papillae, and prickles absent.

ABAXIAL EPIDERMIS IN SURFACE VIEW (FIG. 3C, D)

Zonation. Costal and intercostal zones distinguishable; costal zone 5 to 9 cells wide, the intercostal zone 12 to 18 cells wide. *Intercostal long cells*: rectangular in shape, more than three times as long as wide, the anticlinal walls parallel and undulate, thickened, the end walls vertical; *short cells* solitary, disposed in a row between each successive long cell. *Stomata*: 27–29.5 × 19–24.6 µm, in 3 or 4 rows adjoining the costal zones; subsidiary cells triangular-shaped. *Microhairs*: fusiform, panicoid type, bicellular, 54–66.5 µm long, distal cell with very thin walls and tapered at the apex; basal cells equal or slightly longer than the distal cells. *Macrohairs*: absent. *Papillae*: absent. *Hooks* and *prickles*: absent. Costal silica bodies dumbbell-shaped or cruciform; intercostal silica bodies tall and narrow, transversely elongated.

ADAXIAL EPIDERMIS IN SURFACE VIEW (FIG. 3A, B)

Epidermal cells similar to the abaxial surface, except for the presence of a central band of cells in the intercostal cells, 4 to 8 cells wide; isodiametric or rectangular cells up to 3 times as long as wide.

DISTRIBUTION AND ECOLOGY

Canastra lanceolata is known from eight populations, all in the Brazilian state of Minas Gerais (Fig. 4). Two collections were made in Furnas, including the type collection (*Emygdio et al. 2308* and *Lombardi 877*). The remaining six collections come from Parque Nacional da Serra da Canastra, in Minas Gerais. Plants grow typically among rocks, or very close to the margins of puddles, streams, or small rivers. They are found in shallow and extremely sandy soils. Plants are robust, tussock-like, with conspicuous upright purple inflorescences.

One of the populations sampled inside the Parque grows at the headwater of the great São Francisco River, one of the major rivers in Brazil. Other populations of *C. lanceolata* may be found along the river where it eventually leaves the limits of the Parque. A live plant of *Filgueiras & Rodrigues da Silva 3500* was brought to Brasília and planted on the grounds of Reserva Ecológica do IBGE, where it is growing well.

The genus is named after the Parque Nacional da Serra da Canastra, where six populations of its single species were found. These populations are the only ones legally protected and geographically referenced. The only other population known to us outside the park is situated at Furnas (Minas Gerais).

The Portuguese word "canastra" means "canister" in English and, in this context, alludes to a rocky outcrop that gives its name to the Parque. This outcrop is a curious landmark and bears a striking similarity to a canister when viewed from certain angles. Canastra is also the common name

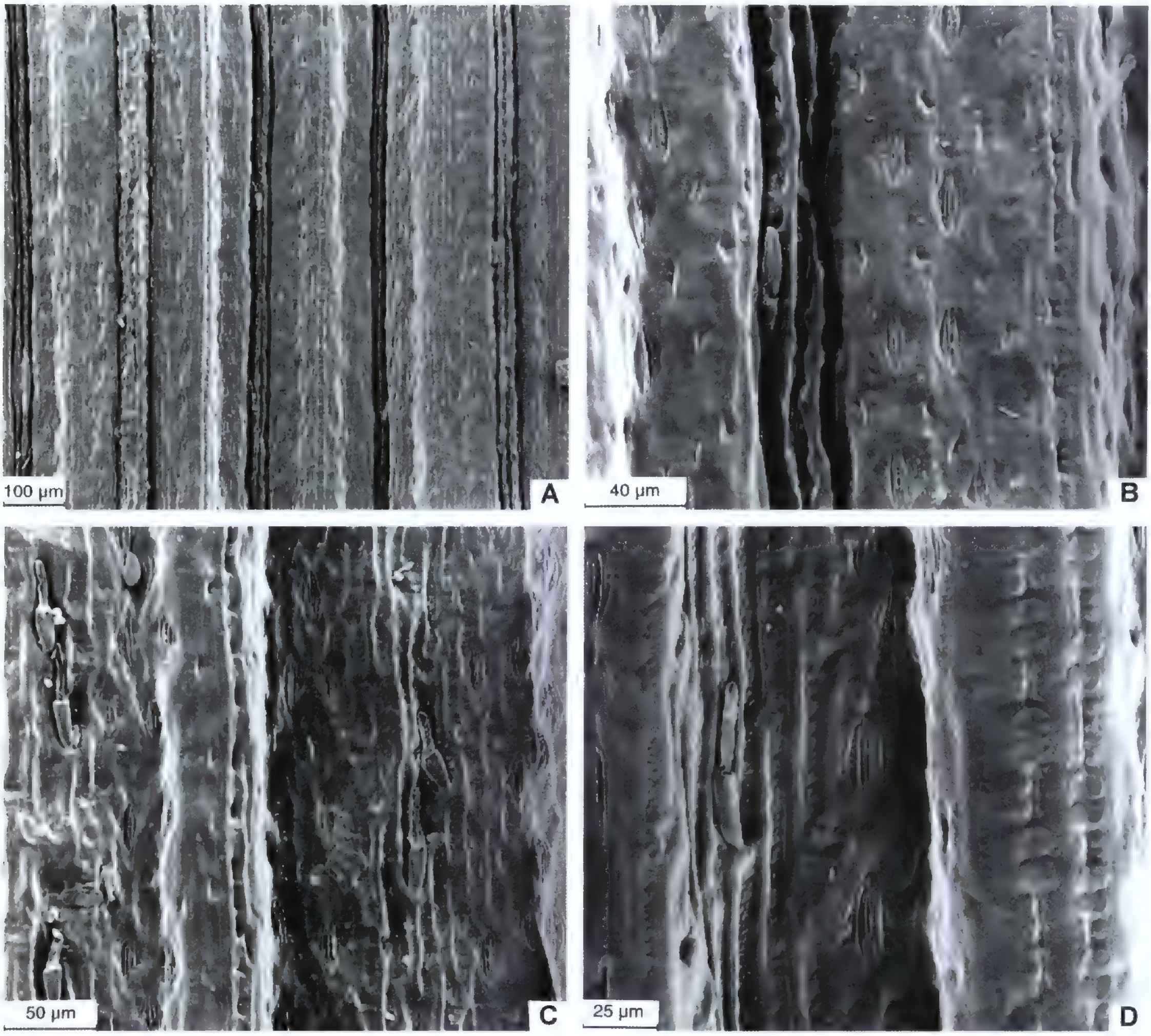


Figure 3. Scanning electron micrographs of the leaf blades of *Canastra lanceolata*.—A. Adaxial epidermis showing costal and intercostal zones. —B. Detailed view of A. —C. Abaxial epidermis showing costal and intercostal zones. —D. Detailed view of C. (*Filgueiras & Rodrigues-da Silva 3588*, SI.)

in Brazil for the giant armadillo (*Priodontes maximus*), often seen in the Parque.

Discussion and Conclusions

Filgueiras (1982) described *Arthropogon lanceolatus* and stated that this species differed from other taxa of *Arthropogon* by the absence of a hairy callus in the base of the spikelet. This author also studied briefly the anatomy of the species but did not mention the fact that *A. lanceolatus* was the only C_3 species of the genus. Filgueiras (1982) related *Arthropogon lanceolatus* to *Arthropogon piptostachyus* (= *Achlaena piptostachya*) by the presence of well-developed bulliform cells. Nevertheless, the latter is a C_4, MS species with distinctive Kranz cells and laterally compressed spikelets.

In a recent cladistic analysis of the tribe Paniceae, using morphological characters, Zuloaga et al. (2000) found that *Canastra lanceolata* was located in a different clade from the one including other species of *Arthropogon*. In this analysis, *C. lanceolata* was related to *Homolepis*, *Streptostachys asperifolia* Desvaux, *Panicum* sect. *Laxa* Hitchcock & Chase ex Pilger, and the Australian genus *Cliffordiochloa* B. K. Simon (the latter likely to be conspecific with *Panicum laxum* of sect. *Laxa*), all taxa with fusoid cells present in the transverse section of the leaves. Zuloaga et al. (2000) stressed that *Arthropogon* is not a monophyletic genus and should be segregated into three monophyletic units, which correspond to *Altoparadisium*, *Arthropogon*, and *Canastra*.

Subsequently, Filgueiras et al. (2001), after the collection of a previously undescribed grass in central Brazil, conducted a detailed study of *Arthropogon* and related genera, including a phylogenetic

Figure 4. —A. View of the Rio Preto site, Parque Nacional da Serra da Canastra, Brazil. Plants of *Canastra lanceolata* growing on rocks in the river (lower left; photo by TSF). —B. Plants of *Canastra lanceolata* at the headwater site of the São Francisco river, Parque Nacional da Serra da Canastra (photo by TSF).

analysis. They segregated the new genus *Altoparadisium* (with two species), related to *Arthropogon*, and indicated that the cladistic analyses of the group clearly supported the idea of separating *A. lanceolatus* from the genus *Arthropogon*. They also noted that further studies were necessary to ascertain the systematic position of this taxon within the tribe. In their cladistic analyses, *C. lanceolata* was placed together with *Homolepis aturensis* (Kunth) Chase, and *Streptostachys asperifolia*, again in a

Table 1. Morphological and anatomical comparison of *Canastra* with related taxa of Paniceae.

Taxon characters	*Canastra*	*Arthropogon*	*Altoparadisium*	*Homolepis*	*Streptostachys asperifolia*	*Panicum* sect. *Laxa*	*Panicum* sect. *Lorea*	*Panicum* sect. *Prionitia*	*Achlaena*
Anatomical type	C_3	C_4 MS	C_4 MS	C_3	C_3	C_3	C_3	C_4 MS	C_4 MS
Fusoid cells	present	absent	absent	present	present	present	absent	absent	absent
Distinctive Kranz Cells	absent	absent	present	absent	absent	absent	absent	absent	present
Compression of the spikelet	dorsiventral	lateral	dorsiventral	dorsiventral	dorsiventral	dorsiventral	dorsiventral	dorsiventral	lateral
Hairy callus	absent	present	present	absent	absent	absent	absent	absent	present
Stipe	absent	absent	absent	absent	present, and torose	absent	absent	absent	present, and pointed
Lower glume (LG)	awned	awned	absent or awned	muticous	muticous	muticous	muticous	muticous	awned
Length of the LG relative to spikelet	1/3	1/2–3/4	absent or reduced	1/1	2/3–4/5	1/3–2/4	1/2–4/5	1/2–3/4	reduced
Nervation of LG	1-nerved	3-nerved	1-nerved	5–9-nerved	5–7-nerved	1–3-nerved	1–5-nerved	3-nerved	1-nerved
Upper glume (UG)	awned	awned	awned	muticous	muticous	muticous	muticous	muticous	awned
Texture of UG	herbaceous	coriaceous	herbaceous	herbaceous	herbaceous	herbaceous	herbaceous	herbaceous	coriaceous
Lower flower	present	present	absent	present or absent	absent	present or absent	present or absent	present	absent
Upper anthecium	cartilaginous	hyaline	hyaline	indurate	indurate	membranous to indurate	indurate	indurate	hyaline
Hilum	punctiform	punctiform	punctiform	linear 1/1	linear 1/1	punctiform	punctiform	punctiform	punctiform

clade supported by the presence of fusoid cells in the three taxa already cited.

Finally, in a recent phylogenetic study of the tribe, using molecular data of the gene *ndh*F, Giussani et al. (in press) determined that *Canastra lanceolata* appears in a separate clade from *Arthropogon*. *Canastra lanceolata* is related to *Panicum euprepes* Renvoize (*Panicum* sect. *Lorea* Zuloaga) and *P. prionitis* Nees (*Panicum* sect. *Prionitia* Zuloaga), and this clade is supported by 85% bootstrap value. It should be mentioned that within this clade the length of each terminal branch is 15, 20, and 11 steps long, for *C. lanceolata*, *P. euprepes*, and *P. prionitis*, respectively. Therefore, these values probably reflect a low similarity among these taxa (Giussani et al., in press).

Canastra is characterized by its dorsiventrally compressed spikelets without a hairy callus, with the lower and upper glume awned, the lower glume reduced and 1-nerved, the upper anthecium cartilaginous, thicker than the upper glume and lower lemma, and the upper lemma enclosing the tip of the upper palea. Anatomically, the genus is non-Kranz, with distinctive fusoid cells in the mesophyll. The new genus and related taxa within the Paniceae are compared in Table 1.

KEY TO DISTINGUISH *CANASTRA* FROM RELATED TAXA

1. Lower and upper glume awned 2
1′. Lower and upper glume muticous 5
2(1). Spikelets dorsiventrally compressed 3
2′. Spikelets laterally compressed 4
3(2). Hairy callus absent; lower flower present; upper anthecium cartilaginous; plants non-Kranz with fusoid cells . . . . . *Canastra*
3′. Hairy callus present; lower flower absent; upper anthecium hyaline; plants Kranz without fusoid cells . . . . . *Altoparadisium*
4(2). Spikelets stipitate; distinctive Kranz cells present . . . . . *Achlaena*
4′. Spikelets not stipitate; distinctive Kranz cells absent . . . . . *Arthropogon*
5(1). Hilum punctiform; lower glume 1/5 to 3/4 the length of the spikelet . . . . . *Panicum*
5′. Hilum linear; lower glume 2/3 to 1/1 the length of the spikelet 6
6(5). Spikelets stipitate; lower lemma without glandular microhairs . . . . . *Streptostachys*
6′. Spikelets not stipitate; lower lemma with numerous glandular microhairs . . . . . *Homolepis*

Acknowledgments. We gratefully thank IBAMA for granting TSF free access to Parque Nacional da Serra da Canastra to collect specimens of *C. lanceolata* and to study local populations. The Director of the Parque and his staff were especially interested and helpful. The Departamento de Botânica da Universidade de Brasília (through Augusto Franco) provided a field vehicle and a driver for the 1999 trip to the Parque. We acknowledge the help given by Robson Rodrigues-da Silva (TSF's graduate student) and by Sr. Mendes (driver) during the long, hasty trip to the Parque in 1999. TSF also thanks the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for a productivity research grant (Process nr. 301190/86–0). We also thank Vladimiro Dudás for the illustrations.

Literature Cited

Breakwell, E. 1914. A study of the leaf anatomy of some native species of the genus *Andropogon* (Gramineae). Proc. Linn. Soc. New South Wales, ser. 2, 39: 385–394.

Ellis, R. P. 1976. A procedure for standardizing comparative leaf blade anatomy in the Poaceae. I. The leaf blade as viewed in transverse section. Bothalia 12: 65–109.

———. 1979. A procedure for standardizing comparative leaf blade anatomy in the Poaceae. II. The epidermis as seen in surface view. Bothalia 12: 641–672.

Filgueiras, T. S. 1982. Taxonomia e distribuição de *Arthropogon* Nees (Gramineae). Bradea 3(36): 303–322.

———, G. Davidse, F. O. Zuloaga & O. Morrone. 2001. The establishment of the new genus *Altoparadisium* and a reevaluation of the genus *Arthropogon* (Poaceae, Paniceae). Ann. Missouri Bot. Gard. 88: 351–372.

Giussani, L. M., J. H. Cota-Sánchez, F. O. Zuloaga & E. A. Kellogg. In press. A molecular phylogeny of the grass subfamily Panicoideae (Poaceae) shows multiple origins of C_4 photosynthesis. Amer. J. Bot.

Metcalfe, C. R. 1960. Anatomy of the Monocotyledons. Vol. 1: Gramineae. Clarendon Press, Oxford.

Zuloaga, F. O., R. P. Ellis & O. Morrone. 1992. A revision of *Panicum* subgenus *Phanopyrum* section *Laxa* (Poaceae: Panicoideae: Paniceae). Ann. Missouri Bot. Gard. 79: 770–818.

———, O. Morrone & L. M. Giussani. 2000. A cladistic analysis of the Paniceae: A preliminary approach. Pp. 123–135 *in* S. W. L. Jacobs & J. Everett (editors), Grasses: Systematics and Evolution. CSIRO, Melbourne.

A(nother) New Species of *Villarsia* (Menyanthaceae) from South Africa

Robert Ornduff†

Department of Integrative Biology, University of California, Berkeley, California 94720-3140, U.S.A.

ABSTRACT. A third species of *Villarsia* from South Africa, *V. manningiana* sp. nov., differs from *V. capensis* and from *V. goldblattiana* in one or more of these characters: size of leaves and inflorescences, length of pedicels, number of flowers per inflorescence, number of ovules per ovary, and surface of seeds. As now circumscribed, *V. capensis* consists of an eastern and a western suite of local populations within the Western Cape Province.

Key words: Menyanthaceae, South Africa, *Villarsia.*

In 1999, I described a second species of *Villarsia, V. goldblattiana,* endemic to the southern Cape Peninsula of South Africa. Prior to 1999, only a single species of *Villarsia, V. capensis* (Houttuyn) Merrill, was recognized for Africa.

Villarsia capensis is based on a collection by Carl Peter Thunberg and consists of specimens that have larger leaves, taller inflorescences, and other floral characteristics that separate them from smaller plants also referred (until now) to *V. capensis.* It is probable that Thunberg collected his specimens at the eastern edge of the range of *V. capensis* near the Krom River; more recent collections from that region match his specimens in size and other vegetative and inflorescence features. Additional collections of the larger form also have been made ca. 100 km northeast of Cape Town near the western end of the range of *V. capensis.* Robert Compton, on the label of his *10900* (NBG) from the Ceres area, wrote that his specimens looked "very different from the Table Mountain swamp-plant!" Thunberg (1823) mentioned that *V. capensis* "crescit in Krumrivier [= Krom River] et in summo Taffelberg." Although the Table Mountain plants belong to the smaller variant, Thunberg clearly considered his two gatherings conspecific. In my 1999 paper, I commented on the existence of these variants and stated, "No taxonomic separation of these two forms is suggested at present." Up to that time, I had not seen plants of the larger form in the field, did not know whether populations of the larger form display a range of morphological variation, and had no evidence that the features that characterize the larger plants in the field are maintained in cultivation when grown alongside the more common smaller variant.

In early September 1998, in company with John Manning, Peter Goldblatt, and W. L. Culberson, I visited the farm (Ruigtevlei) where the amateur botanist I. B. Walters had collected the large variant in 1976 (*Walters 1557,* NBG), the most recent collection that I have seen. This farm is in the Slanghoek valley between Rawsonville and Dutoitskloof, ca. 75 km east-northeast of Cape Town. Although the farm occupies several hundred hectares, the landowner (P. P. van der Merwe) drove us to a likely site based on my description of presumed habitat characteristics. There I found a localized population of *Villarsia* in vegetative condition growing in wet, peat soil and in living *Sphagnum* in the shade among restionads and small shrubs. I dug up 12 individuals from throughout the site and brought them back to Berkeley, California, where they have grown and flowered for two seasons in an unheated greenhouse. In cultivation, these plants have retained the vegetative and inflorescence characteristics that distinguish them from the smaller variant also referred to *V. capensis* (as exemplified by individuals grown in Berkeley at the same time that originated at Nuweberg in 1990).

It is the larger variant to which the name *V. capensis* applies (Ornduff, 1999), and I consider that the larger and smaller variants are sufficiently different from each other that the smaller variant merits its recognition as a third species of *Villarsia* in Africa. I am naming it *Villarsia manningiana* in

†Deceased 22 Sep. 2000. Prof. Ornduff had essentially completed the manuscript for this paper. With help from Dale E. Johnson and Peter Goldblatt, Ornduff's manuscript was lightly edited in December 2000 by John L. Strother, University Herbarium, 1001 Valley Life Sciences Building # 2465, University of California, Berkeley, California 94720-2465, U.S.A. strother@uclink4. berkeley.edu.

appreciation of John Manning's considerable assistance to my studies of *Villarsia* in South Africa and in recognition of his important contributions to southern African biology, including the systematics of the Leguminosae, Iridaceae, and other plant families, his contributions to southern African entomology and to pollination biology, his coauthorship of two excellent regional wildflower guides, and his superb botanical illustrations.

Villarsia manningiana Ornduff, sp. nov. TYPE: South Africa. Western Cape Province: small perennial in wet boggy places, perianths bright yellow, frequent, Kogelberg, at the summit, Caledon District, 4100 ft., 20 Nov. 1967, *J. P. Rourke 992* (holotype, NBG–86508).

Villarsiae capensi et *V. goldblattianae* affinis sed differt in his characteribus: lamina folii longissimi 25–50 mm ($\bar{x}$ = 39 mm) longa, 10–27 mm ($\bar{x}$ = 19 mm) lata; inflorescentia elatissima 13–29 cm ($\bar{x}$ = 21 cm) elata, floribus 7–32 ($\bar{x}$ = 18); pedicellus longissimus 13–25 mm ($\bar{x}$ = 18 mm) longus; semina papillosa.

Perennials, erect, tufted, nonstoloniferous. Basal leaves erect, evergreen; petioles 2–17 cm long; blades fleshy, oblong to ovate, 10–50 mm long, 5–27 mm wide, rounded to cordate at base, usually with widely spaced, shallow teeth, occasionally entire; cauline leaves gradually reduced to scales distally. Inflorescences congested to open panicles with 7 to 32 flowers; the tallest inflorescences 13–29 cm tall, 0.9–1.6 times the length of the longest leaves; pedicels 5–25 mm long. Flowers distylous, open for only 1 day. Calyx lobes 5, ± lanceolate, 4–5.5 mm long, 2–2.5 mm wide at their bases. Corollas yellow, lobes 5, linear to broadly obovate, sometimes winged, about twice the length of the calyx lobes, the margins fimbriate, usually hairy on portions of the upper surfaces. Ovules 1 or 2 per ovary. Capsules ovoid, equaling or slightly longer than the calyx lobes. Seeds yellow or brown, ± orbicular, biconvex, usually with uniformly scattered papillae, sometimes sparsely papillate or nearly smooth.

Growing in wet soil, marshes, and stream margins, 244–1524 m.

Flowering mostly September to December.

Paratypes. SOUTH AFRICA. **Western Cape Province:** common in damp places, herbaceous with basal leaves on long pedicels (sic), flowers yellow with fringed edges, opening only in sunlight, Grabouw-Nuweberg Forest Station, alt. 500 m, 29 Oct. 1983, *C. Burman 1238* (BOL); perennial herb with basal leaves, fls. yellow, on wet humus-rich marshy soil, Swartboskloof, Stellenbosch District, 5000 ft., 30 Oct. 1960, *W. L. J. van Rensburg 2030* (BOL); E slopes of Somerset Sneeuwkop, Caledon Division, 3500–4000 ft., Dec. 1939, *E. Esterhuysen 2791* (BOL); Bains-Kloof, 2700 ft., Nov. 1896, *R. Schlechter 9174* (BOL); Baviaans Kloof, off Bains Kloof, Paarl Division, 20 Oct. 1946, *F. M. Leighton 2153* (BOL); Happy Valley, W of Bain's Kloof, 12 Sep. 1970, *R. Ornduff 7267* (UC); in uliginosis ad fluv. Rivier Zonder Ende, locis montosis (Caledon), Nov., no collector (BOL-62343); flowers yellow, note slight toothing of leaves, Kogel Berg, Caledon, 16 Nov. 1944, *W. F. Barker 3312* (NBG); damp places, frequent, Vogelgat, Sip Lodge, Caledon Division, 1 Sep. 1979, 420 m, *I. Williams 2821* (NBG); Tulbagh Waterfall, 800 ft(?), 12 Oct. 1890, *F. Guthrie 2095* (NBG); Pringle Peak, Caledon, 12 Nov. 1954, *B. Maguire 2655* (NBG); fl. yellow, in marshy or moist spots, along plateau path etc., Harold Porter Reserve, Simonstown, ± 1000 ft., 12 Oct. 1989, *E. Esterhuysen 36858* (NBG); becoming more frequent at higher elevations, petals yellow, hairy, herb with fleshy leaves, mountain slopes with S to SW aspect . . . N of Pringle Bay, Caledon Dist., 1200–2500 ft., 4 Nov. 1951, *H. B. Rycroft 1231* (NBG); in summo monte Tabulari, 3500 ped., Dec. 1877, *H. Bolus 4798* (BOL); marshy places, fl. yellow, Table Mt., 2 Jan. 1948, *R. J. Rodin 3204* (BOL); near streams & in swampy places on plateau, above Window Gorge, Table Mt., 2500 ft., 6 Dec. 1945, *E. Esterhuysen 12296* (BOL); swampy places, Table Mountain, Dec. 1907, *E. P. Phillips 153* (NBG); Lower Plateau near Wynberg Reservoir, 20 Oct. 1895, *A. H. Wolley Dod 167* (BOL); Prope Worcester, circa 800 ped., Jan., *H. Bolus s.n.* (BOL); growing along edge of pool, flowers yellow, petal edges frilly, Steenbras River catchment area, 1 Oct. 1981, *D. Snijman 558* (NBG); in and at edge of "river" on Sir Lowry's Pass at junction of road to Steenbras Reservoir, 10 Nov. 1970, *R. Ornduff 7613* (UC); common, in parts almost pure (gregarious) on wetter portion of burnt veld, Hoogeberg, Knysna, 2500 ft., 20 Oct. 1922, *J. D. Keel 982* (UC).

Key to South African Species of *Villarsia*

1a. Petioles of longest leaves 19–32 cm ($\bar{x}$ = 24 cm) long; tallest inflorescences more than 53 cm tall; ovules ca. 6 per ovary . . . . . *V. goldblattiana*

1b. Petioles of longest leaves 7–23 cm ($\bar{x}$ = 12.5 cm) long; tallest inflorescences less than 50 cm tall; ovules 2 per ovary.

2a. Blades of longest leaves 50–90 mm ($\bar{x}$ = 61 ± 14 mm) long, 23–60 mm ($\bar{x}$ = 34 ± 14 mm) wide; tallest inflorescences 27–50 cm ($\bar{x}$ = 37 ± 8.3 cm) high with 40–85 ($\bar{x}$ = 57 ± 17) flowers; longest pedicels 7–17 mm ($\bar{x}$ = 11 ± 3 mm) long; seeds smooth or minutely and densely papillate on outer 0.5 mm of seed margin . . . . . *V. capensis*

2b. Blades of longest leaves 25–50 mm ($\bar{x}$ = 39 ± 9 mm) long, 10–27 mm ($\bar{x}$ = 19 ± 4 mm) wide; tallest inflorescences 13–29 cm ($\bar{x}$ = 21 ± 5 cm) high, with 7–32 ($\bar{x}$ = 18 ± 5) flowers; longest pedicels 13–25 mm ($\bar{x}$ = 18 ± 6 mm) long; seeds usually with uniformly scattered papillae, sometimes sparsely papillate or nearly smooth . . . . . *V. manningiana*

An excellent photograph of a flowering individual of *V. manningiana* is in Burman and Bean (1985), a watercolor sketch is in Moriarity (1982), and a photograph of a flower is in Jackson (1982).

I have authored or coauthored papers that now

contain erroneous identifications of South African *Villarsia* because at the time they were published only *V. capensis* was recognized for Africa. In a paper on pollen by Nilsson and Ornduff (1973), specimens referred to *V. capensis* are *V. manningiana* except for my collection number *7099*, which is *V. goldblattiana*. In a paper on cytology (Ornduff, 1974), two of the three chromosome counts reported for *V. capensis* are for *V. manningiana* and the third (my no. *7099*) is for *V. goldblattiana*. The seeds illustrated by Chuang and Ornduff (1992) are those of *V. manningiana*, not *V. capensis*.

Oddly, though *V. capensis* is by far the most widely distributed of the South African species of *Villarsia*, much less is known about it than about the two restricted species.

The three South African species of *Villarsia* are distylous. Results of a pollination program using a single accession of *V. manningiana* indicated that in this population, distyly is associated with a strong incompatibility system (Ornduff, unpublished). The breeding system of the other two South African *Villarsia* species is unknown. The sample of living plants from the Slanghoek population of *V. capensis* produced six long-styled plants and five short-styled plants, suggesting a 1:1 morph ratio. This ratio is supportive of the possibility that this species possesses an incompatibility system associated with distyly, or at least that intermorph fertilizations are much more common than are intramorph ones. In the field, the Slanghoek plants possessed no spent inflorescences from prior flowering seasons, suggesting that flowering in this population may decline when fire has not removed the shrub cover and the consequent shading. This is consistent with my suggestion that the function of fire in inducing flowering in *V. goldblattiana* is primarily one of increasing light intensity at ground level by a temporary reduction in shading by the dense overstory of fynbos shrubs and graminoid plants (Ornduff, 1999).

Because *V. goldblattiana* and *V. manningiana* have been separated from *V. capensis*, the range of *V. capensis*, as now circumscribed, occupies disjunct western and eastern areas within the Western Cape Province.

Representative western collections of *V. capensis* are: vlei, yellow, Cold Bokkeveld, 8 Dec. 1940, *R. H. Compton 10900* (NBG); height 3 ft., 1900 ft. elevation, Ceres Mountains, Jan. 1892, *Guthrie 2191* (NBG); yellow, frequent to 40 cm in sandy soil, 'Ruigtevlei' farm, Slanghoek, Rawsonville, 7 Nov. 1976, *I. B. Walters 1557* (NBG).

Representative eastern collections of *V. capensis* are: in vlei, fl. yellow, 800 ft., Kirby, 4 Dec. 1942, *H. G. Fourcade 5902* (BOL); fls. yellow, in vlei, Ralets [sic] Bosch [= Ratelsbosch] flats, 750 ft., Jan. 1909, *H. G. Fourcade 396* (BOL); in rivulo, Wagenbooms R., Long Kloof, 1870, *H. Bolus 2404* (BOL; mounted with *H. Bolus 4798* and *J. Ecklon s.n.* in 1824, both *V. manningiana*).

Literature Cited

Burman, L. & A. Bean. 1985. Hottentots Holland to Hermanus: South African Wild Flower Guide 5. Botanical Society of South Africa, Claremont.

Chuang, T. I. & R. Ornduff. 1992. Seed morphology and systematics of Menyanthaceae. Amer. J. Bot. 79: 1396–1406.

Jackson, W. P. U. 1982. Wild Flowers of Table Mountain (rev. ed.). Howard Timmins, Cape Town.

Moriarity, A. 1982. Outeniqua, Tsitsikamma & Eastern Little Karoo; South African Wildflower Guide 2. Botanical Society of South Africa, Claremont.

Nilsson, S. & R. Ornduff. 1973. World Pollen and Spore Flora. 2. Menyanthaceae Dum. Almqvist & Wiksell Periodical, Stockholm.

Ornduff, R. 1974. Cytotaxonomic observations on *Villarsia* (Menyanthaceae). Austral. J. Bot. 22: 513–516.

———. 1999. A new species of *Villarsia* (Menyanthaceae) from South Africa. Novon 9: 407–409.

Thunberg, C. P. 1823. Flora Capensis ... ., ed. 2. J. G. Cotta, Stuttgart.

A New Species of *Pittosporum* (Pittosporaceae) from China

Peng Hua

Herbarium, Kunming Institute of Botany, Chinese Academy of Sciences, Heilongtan, Kunming, Yunnan 650204, People's Republic of China

Deng Yunfei

Herbarium, Department of Taxonomy, South China Institute of Botany, Chinese Academy of Sciences, Wushan, Guangzhou, Guangdong 510650, People's Republic of China

ABSTRACT. In 1974, Chang and Yan adopted the name *Pittosporum ovoideum* Gowda 1951, but excluded its holotype, correctly noting that it is a flowering specimen of *P. pauciflorum* Hooker & Arnott. They therefore published the later homonym *P. ovoideum* Hung T. Chang & S. Z. Yan 1974, non Gowda 1951. Gowda's name is a synonym of *P. pauciflorum*. The species described by Gowda as *P. ovoideum* has remained without a legitimate name until the present paper, where it is formally described as *P. lenticellatum* Chun ex H. Peng & Y. F. Deng, sp. nov.

Key words: China, Pittosporaceae, *Pittosporum*.

Chang and Yan (1974: 34) adopted the name *Pittosporum ovoideum* Gowda (1951: 322) but definitely excluded its type, *C. Wang 39113* (holotype, A), correctly noting that it is a flowering specimen of *P. pauciflorum* Hooker & Arnott (because it has three, rather than two, carpels) and explicitly including it under that species (1974: 33). Under Article 48.1 of the *Saint Louis Code* (Greuter et al., 2000), they therefore published the later homonym *P. ovoideum* Hung T. Chang & S. Z. Yan 1974, non Gowda 1951. Gowda's name is a synonym of *P. pauciflorum*, even though the original description and two paratypes of *P. ovoideum* do not belong to *P. pauciflorum*. Chang and Yan (1974: 34) designated one of Gowda's paratypes, *H. Fung 21114* (A), as the holotype (as "Lecto-typus!") of their *P. ovoideum*. They also designated an additional specimen not mentioned by Gowda, *C. N. Teng 13409* ["13469"] (IBSC), as a paratype (as "Fl[ower].-Typus!"). (The use of these terms to denote holotype and paratype can be treated as correctable errors under Art. 9.8 of the Code.) One of us (Peng) has checked the holotype and an isotype (at IBSC) of *P. ovoideum* Gowda, and has come to the conclusion that the judgment of Chang and Yan is correct, i.e., that both these type specimens are indeed *P. pauciflorum*. However, the treatment of Chang and Yan is unsatisfactory because the species described by Gowda as *P. ovoideum* has been left without a legitimate name until the present paper. In 1940, Chun Woon-young annotated specimens of this species (at IBSC) as *P. lenticellatum*. Therefore, that name is adopted here and ascribed by us to Prof. Chun.

Pittosporum lenticellatum Chun ex H. Peng & Y. F. Deng, sp. nov. TYPE: China. Guangxi Zhuangzu Autonomous Region: Yangshuo Xian, climbing over rocks at base of hill "Ch'ing-o-tu," 4–7 Aug. 1937 (fr), *H. Fung 21114* (holotype, IBSC; isotype, A).

Species *Pittosporo planilobo* Hung T. Chang & S. Z. Yan affinis, sed laminis foliorum magniore 4–11 cm longis 1–3 cm latis, capsulis 1.2–1.4 cm latis, seminibus 16 usque ad 24, differt.

Shrubs evergreen, 1–4 m tall. Branchlets verticillate or dichotomous, pubescent, later glabrescent; bark gray or brown, conspicuously speckled with lenticels. Leaves loosely crowded toward apex of branches; petiole 1–1.5 cm; leaf blade narrowly obovate-lanceolate, 4–11 × 1–3 cm, broadest at or above the middle, firmly leathery, pubescent on both surfaces when young, later glabrescent, lateral veins in 8 to 10 pairs, abaxially prominent, adaxially impressed, reticulate veins conspicuous, base cuneate, margin recurved, entire, apex acute or acuminate. Inflorescences pseudoterminal or axillary, umbellate, subumbellate, or 1-flowered, subtended by a whorl of leaves and bracts; bracts narrowly lanceolate, 3–4 × ca. 1 mm, inconspicuously pubescent; pedicels 5–10 mm, pubescent. Flower buds ovoid, ca. 5 mm, densely silky brown hairy, apex acute. Sepals 5, free, yellow, ovate-lanceolate, 3–5 × 1–3 mm, abaxially pubescent, margin ciliate, apex acuminate. Petals 5, free, linear, 5–8 × ca. 2 mm. Filaments 5, ca. 3 mm; anthers oblong, ca. 2 mm. Ovary cylindric, ca. 3 mm, densely silky brown hairy; placentas 2, parietal; ovules 16 to 24;

style 3–4 mm, glabrous; stigma subcapitate. Capsules globose or subglobose, slightly compressed, 1.2–1.4 cm, woody, 2-valved; valves ca. 2 mm thick, subglobose or suboblong, striate and coated with oily substance inside; funicles biseriate, arranged from base to beyond middle of placenta, darkish, knoblike, less than 1 mm. Seeds 16 to 24, darkish red, irregular, ca. 4 × 2 mm.

Phenology. Flowering in March, fruiting from July through September.

Ecology and distribution. Evergreen forests, thickets, limestone mountains; 200–1100 m. Endemic to China, occurring in northern Guangxi and southeastern Guizhou.

Paratypes. CHINA. **Guangxi:** Guilin, 200 m, 1 Apr. 1964, *N. K. Liang & D. Fang 44878* (IBSC), 28 Mar. 1948, *C. N. Teng 13409* (IBSC), 6 July 1937, *W. T. Tsang 27776* (A, IBSC), 9 May 1982, *H. G. Ye 545* (IBSC); Lingui, 23 Nov. 1953, *C. F. Liang 31106* (IBSC); Luocheng, 1939, *M. Chen 84179* (IBSC), *R. C. Ching 5340* (IBSC); Xingan, *Guangxi Expedition 406* (IBSC). **Guizhou:** without locality, *Y. Tsiang 6833* (IBSC); Libo, *X. H. Song 752* (NF), *X. H. Song 1056* (NF), 12 Apr. 1984, *Z. R. Xu L1329 & L1473* (IBSC, SYS).

Acknowledgments. We thank Nicholas J. Turland (MO) for nomenclatural advice, editorial modifications, and for correcting the English. We also thank Zhang Zhiyun (PE) for discussing the taxonomic treatment. This article is the result of part of a major project on the biodiversity of the Mekong River Basin in Yunnan, supported financially by the Chinese Academy of Sciences, grant no. KZ951-A1-104-03.

Literature Cited

Chang, H. T. & S. Z. Yan. 1974. A review of the pittosporaceous plants in China. Acta Sci. Nat. Univ. Sunyatseni 1974(2): 30–43.

Gowda, M. 1951. The genus *Pittosporum* in the Sino-Indian Region. J. Arnold Arbor. 32: 263–343.

Greuter, W., J. McNeill, F. R. Barrie, H. M. Burdet, V. Demoulin, T. S. Filgueiras, D. H. Nicolson, P. C. Silva, J. E. Skog, P. Trehane, N. J. Turland & D. L. Hawksworth (editors). 2000. International Code of Botanical Nomenclature (Saint Louis Code). Regnum Veg. 138.

Taxonomic Evaluation and New Combinations in the *Lupinus gibertianus–L. linearis* Complex (Fabaceae)

Ana María Planchuelo and Elsa Fuentes
ACOR, Facultad de Ciencias Agropecuarias, Universidad Nacional Córdoba, Casilla de Correo 509, 5000 Córdoba, Argentina

Abstract. The *Lupinus gibertianus–L. linearis* complex was evaluated using nomenclature reviews, studies of all type material, and multivariate analysis. The results support the recognition of *L. linearis* Desrousseaux and three varieties of *L. gibertianus* C. P. Smith. The new combinations *L. gibertianus* var. *reineckianus* Planchuelo & E. Fuentes and *L. gibertianus* var. *berroanus* Planchuelo & E. Fuentes are made. Taxonomic keys, descriptions, illustrations, and synonymy are included, and representative specimens are listed.

Resumen. Se evalúa taxonómicamente el complejo *Lupinus gibertianus–L. linearis* realizando una revisión nomenclatural, un estudio de materiales tipos y una evaluación de caracteres morfológicos mediante técnicas de análisis multivariado. Los resultados soportan el reconocimiento de *L. linearis* Desrousseaux y tres variedades de *L. gibertianus* C. P. Smith. Se dan a conocer las nuevas combinaciones *L. gibertianus* var. *reineckianus* Planchuelo & E. Fuentes y *L. gibertianus* var. *berroanus* Planchuelo & E. Fuentes. El trabajo se completa con una clave identificatoria, descripciones, sinonimias, ilustraciones y lista de especímenes representativos de los taxa tratados.

Key words: Fabaceae, *Lupinus*, New World.

Lupinus L. is primarily a New World genus with approximately 600 species (Planchuelo, 1982), which show a range of variation from annual to perennial and from acaulescent or small prostrate to tree-like shrubs up to 4–4.5 m tall (Dunn, 1984). The species treated in this paper, *L. gibertianus* C. P. Smith and *L. linearis* Desrousseaux, grow in eastern South America (Atlantic sub-Region; Planchuelo-Ravelo, 1984; Planchuelo, 1994a), mainly in northeastern Argentina, with few representatives in eastern Brazil, Paraguay, and Uruguay. Both species are clearly different from the simple-leaved lupines (Planchuelo & Dunn, 1984, 1989) and are distinguished from other compound-leaved lupines growing in the same area by the annual habit, indument without spreading hairs, and free tip of the stipules not foliaceous (Planchuelo, 1996b).

Lupinus gibertianus is a polymorphic species, and because of its enormous morphological complexity several taxa have been described at specific and varietal levels. Dunn and Planchuelo (1981) clarified the nomenclatural ambiguity of the taxa involved by accepting *L. gibertianus* as the correct name rather than *L. heptaphyllus* (Vellozo) Hassler or *L. hilarianus* Bentham, pending the evaluation of morphological characters. Dunn (1984) pointed out that this species is essentially self-pollinated, with numerous genetic differences by geographic area. *Lupinus linearis*, native to the same areas as *L. gibertianus*, is a closely related species differing mainly by its branching structure and leaflet shape. Both species were treated by Planchuelo-Ravelo (1991) and Planchuelo (1996a) as a complex with great morphological variation and sympatric distribution.

Chemotaxonomic evaluation of alkaloid profiles (Planchuelo-Ravelo et al., 1993; Planchuelo, 1994b), seed oil components (Fuentes & Planchuelo, 1997), alkanes of leaf waxes (Merino et al., 1999), and flavonoids (Merino et al., 2000) shows that *L. linearis* and *L. gibertianus* have phytochemical patterns very different from other lupines growing in South America. The major alkaloid and alkane components of *L. gibertianus* and *L. linearis* are similar, although differences in qualitative and quantitative patterns were found between the two species and the vouchers that represent different populations of *L. gibertianus* (Planchuelo, 1994b; Merino et al., 1999).

In an effort to define the taxa of this complex, numerous herbarium specimens as well as type materials, when available, were evaluated. Vegetative and floral characters were analyzed by numerical taxonomy techniques.

Materials and Methods

This study is based chiefly on herbarium specimens from the following herbaria: ACOR, B, BA, BAA, BAB, BAF, CORD, CTES, DS, F, G, K, LIL, LP, LSR, MO, P, RNG, SI, UC, UMO, and US. Information on habitat and ecology of the species was

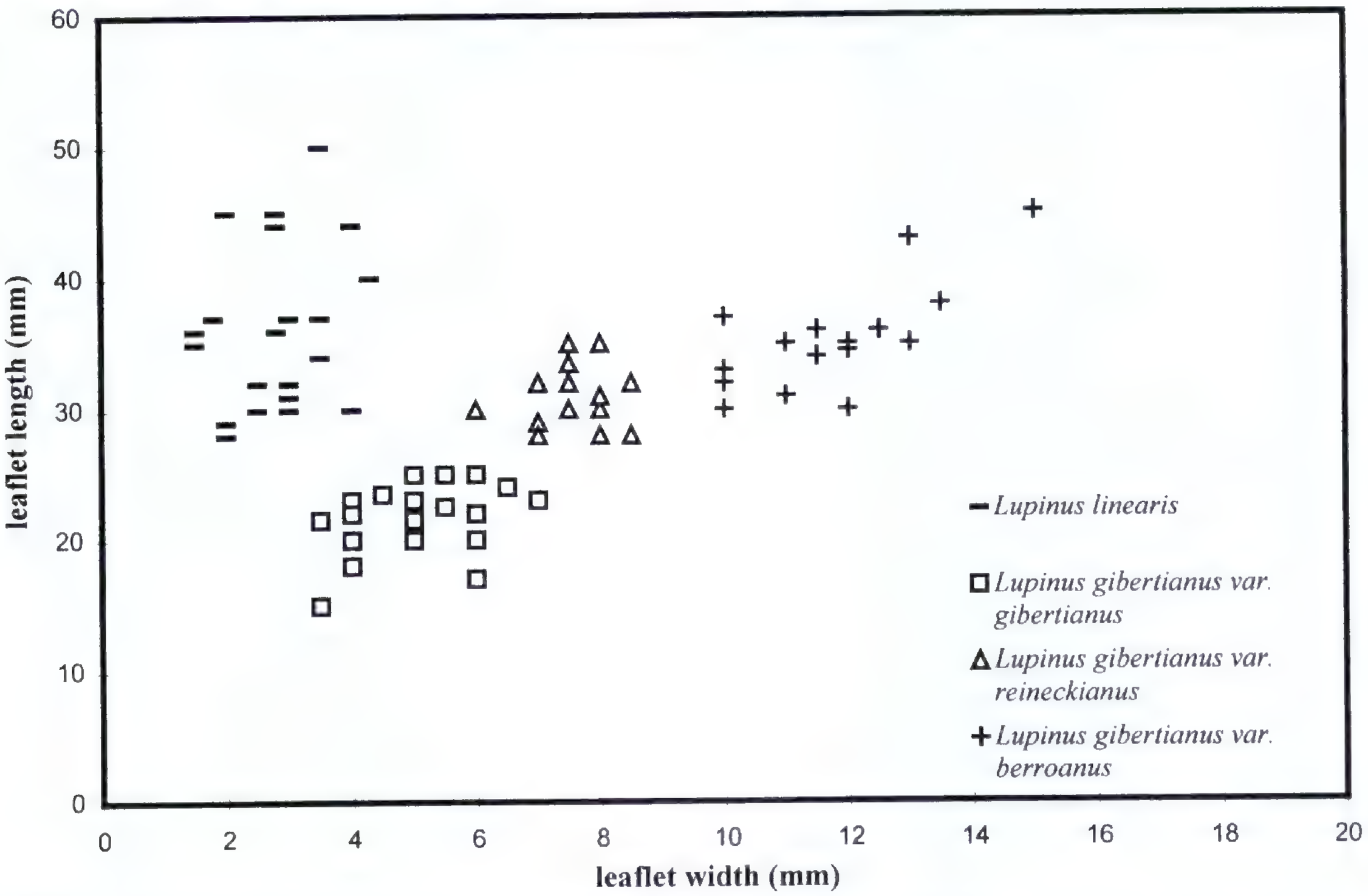


Figure 1. Scatter diagram showing the leaflet length and maximum width relationship of the 90 voucher specimens that are marked by an asterisk in the specimens examined lists (due to overlap, only 70 are distinguished in the diagram).

taken from herbarium specimen labels and from personal observations of the plants in the field.

Representative specimens of *L. linearis* and *L. gibertianus*, as well as type material of names treated in Dunn and Planchuelo (1981), were included in the data matrices in order to establish the relationship between the taxa. Vegetative and floral structures were studied, and measurements were taken from fully mature organs according to Planchuelo (1978). Each character was considered an independent variable, and the data recorded was the mode of that character for each specimen. To evaluate the differences in leaflet sizes and shapes, a scatter diagram was constructed with 90 data entries using leaflet length and leaflet width as parameters. Specimens cited herein and included in this analysis are marked by asterisks (*). The data matrix is available upon request from the author. A leaflet shape coefficient (LSC), based on the relationship between the width at midpoint and the maximum width of the leaflets, was developed to characterize the differences between linear and oblanceolate leaflet shapes.

LSC = Wmid/Wmax

Where:

LSC = Leaflet Shape Coefficient

Wmid = leaflet width at leaflet mid-point

Wmax = maximum leaflet width

Numerical Taxonomy and the Multivariate Analysis System (Rohlf, 1992) were applied in order to evaluate a wide range of vegetative and floral characters. Fourteen morphometric parameters relative to size and shape were evaluated for the 50 Operational Taxonomic Units (OTUs): petiole (length), leaflets (length, maximum width, half-length width, LSC), stipules (free portion length, free portion width), calyx (lower lip length, upper lip lobe width), and corolla (banner length, banner maximum width, wing length, wing width, keel width). The voucher specimens are identified by their OTU's number (in brackets) in the list of representative specimens. The data matrix was analyzed using distance coefficients and the unweighted pair grouping method of arithmetic average (UPGMA) (Crisci & López Armengol, 1983).

Results

The scatter diagram (Fig. 1) shows four major groups, one corresponding to *L. linearis* and the other three we recognize as varieties of *L. gibertianus*. Due to overlap, only 70 of the 90 data entries are distinguished in the diagram.

The phenetic cluster analysis (Fig. 2) shows two

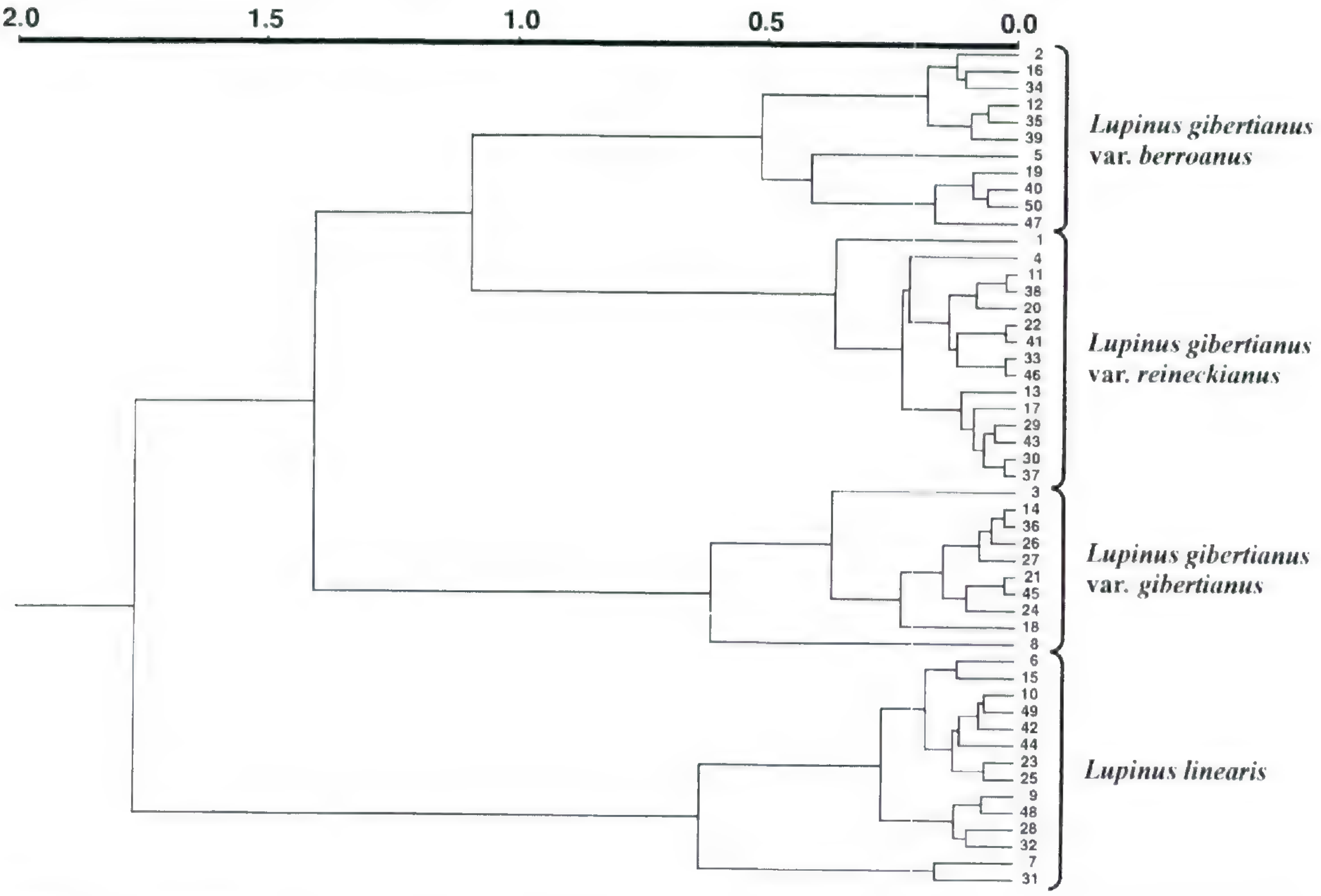


Figure 2. Phenogram of 50 OTUs based on 14 vegetative and floral characters analyzed by a distance coefficient and unweighted pair grouping method of arithmetic average (UPGMA).

main groups. One cluster comprises all representative OTUs of *L. linearis*, and the other cluster has two secondary branches. One of them includes all specimens of *L. gibertianus* var. *gibertianus*, and the other is divided into two tertiary branches that represent *L. gibertianus* var. *berroanus* and *L. gibertianus* var. *reineckianus*.

These results show that *L. linearis* is clearly separate from *L. gibertianus* and that subdivisions within *L. gibertianus* can be recognized. The characters enumerated in the following key allowed the identification of the species and the varieties proposed.

KEY TO THE SPECIES AND VARIETIES OF THE *LUPINUS GIBERTIANUS–L. LINEARIS* COMPLEX

1a. Juvenile plants with a basal rosette of leaves, adult plants usually branching below; leaflets (28–)30–50 × 1.5–3.5(–4.5) mm, linear or occasionally narrowly lanceolate-attenuate; Leaflet Shape Coefficient (LSC) = 1; racemes terminal not appearing lateral . . . . . 1. *L. linearis*

1b. Juvenile plants without a basal rosette of leaves, adult plants usually branching above; leaflets (15–)20–40(–45) × (3–)4–12(–15) mm, narrowly to broadly oblanceolate, not linear or lanceolate-attenuate, when less than 4.5 mm wide no longer than 25 mm; LSC = 0.60–0.90; racemes terminal but sometimes appearing lateral when the top lateral bud grows rapidly and vertically . . . . . 2. *L. gibertianus*

2a. Leaflets 15–25 × (3.5–)4–6(–7) mm; free portion of the stipules 1.5–2.5 × 0.5–1 mm; standard petal 7–8 × 4.5–6 mm . . . . . 2a. *L. gibertianus* var. *gibertianus*

2b. Leaflets 28–40(–45) × (6–)7–13(–15) mm; free portion of the stipules 3–4(–5) × 1–1.5 mm; standard petal 8–11 × 7–10 mm.

3a. Leaflets (6–)7–8.5(–9) mm wide, oblanceolate, apex acute; LSC = 0.80–0.90; standard petal 10–11 × 9–10 mm . . . . . 2b. *L. gibertianus* var. *reineckianus*

3b. Leaflets 10–13(–15) mm wide, broadly oblanceolate, apex obtuse to rounded; LSC = 0.60–0.79; standard petal 8–10 × 7–9 mm . . . . . 2c. *L. gibertianus* var. *berroanus*

1. Lupinus linearis Desrousseaux, Lam. Encyclop. 3: 625. 1791. TYPE: Uruguay. Montevideo, Oct. 1925, *Commerson s.n., Herb. de Jussieu* (holotype, P-JU; ACOR photo, F photo).

Lupinus pseudolinearis (Hassler) C. P. Smith, Spec. Lupinorum 21: 332. 1943. Syn. nov. Basionym: *Lupinus heptaphyllus* f. *pseudolinearis* Hassler, Repert. Spec. Nov. Regni Veg. 16: 158. 1919. *Lupinus hilarianus* var. *pseudolinearis* (Hassler) C. P. Smith, Spec. Lupinorum 14: 212. 1940. TYPE: Argentina. Misiones: Posadas, 2 Oct. 1911, *Muniez 6* (lectotype, selected

Figure 3. *Lupinus linearis* Desrousseaux. —A. Habit. —B. Leaf, adaxial side. (Drawn from *Planchuelo 651*, ACOR.)

here, G—plant designated as B; isolectotype, BAF—plant designated as A only).

Plants annual, 7–40 cm tall. Juvenile plants with a basal rosette of leaves, adult plants branching below. Stems 2–4 mm diam., slender, somewhat angular from the midveins of the petioles, hollow to fistulous, sparsely strigose to glabrous below, hairs more numerous above; internodes 2–3 cm long. Stipule 4–7 mm long, strigose dorsally, the lanceolate-attenuate free tips 2–5 × 0.5–1 mm. Leaves palmate-compound with 7 to 10 leaflets; petioles (2.5–)4.5–7 cm long, with a green rib on both sides ca. 0.5–0.8 mm wide, pubescence as stems; leaflets linear or occasionally narrowly lanceolate-attenuate, (28–)30–50 × 1.5–3.5(–4.5) mm, mostly conduplicate some complanate, glabrous above, ascending-pilose below, tips acute, with an LSC equal to 1. Racemes terminal, 5–9 cm long, with 15 to 35 flowers, scattered. Bracts ovate-lanceolate, 4 × 1.5 mm, caducous, strigose to sericeous dorsally. Bracteoles lanceolate, 1.0–1.5 × 0.3–0.5 mm, attached ca. 0.3 mm below the lips of the lateral sinuses of the calyx. Pedicel strigose, 1–2 mm long at anthesis, 3–4 mm in fruit. Calyx subsericeous outside, glabrous within, the base not gibbous above, lips 1.5–2.5 mm connate; lower lip lanceolate, 7–9 × 2–3 mm, tridentate, the central tooth 1–2 × 1 mm, the two lateral teeth much smaller; upper lip 5–6 mm long, the lobes 3–4 × 1.5–2 mm. Corolla variable in color changing from intense blue to light blue without purplish tint. Standard petal ovate-obovate, 8–11 × 5–10 mm, clawed, glabrous, appressed 3.5–4 mm, reflexed to 5.5–7 mm, reflexed/appressed: 1.5–1.8, the angle 110–120°. Wings 9–11 mm long including a 2–2.5 mm claw, 4–6 mm wide, lobe above the claw 1.5–2 mm wide. Keel 2.5–4 mm wide in the middle, glabrous, tip blunt, the angle 95–100°. Ovules 8 to 10. Legumes 3–3.8 × 0.5–0.7 cm, sericeous. Seeds 3–4 × 2.6 mm, brown with tan mottling.

Iconography. Figure 3; Planchuelo, 1996a: 111, fig. 1.2.

Phenology. Flowering specimens have been collected from mid September through November, and fruiting specimens from mid November through January.

Habitat. The species grows in open fields with sandy soils and along riverbanks.

Distribution. This species occurs mainly in

northeastern Argentina, Uruguay, Paraguay, and southern Brazil.

Discussion. When C. P. Smith made the new combination *L. hilarianus* var. *pseudolinearis* (Hassler) C. P. Smith, he assigned as type material the collection *Muniez 6* in G and stated "the lefthand specimen alone should stand as the type, since the righthand specimen does not check with the original designation of 'linearibus,' having its leaflets much shorter and linear-oblanceolate, mostly flat." Later, in 1943 when he recognized the variety as a species, he explained, "This diagnosis is also largely based upon what can be seen in our photograph of the type, taken by us in Geneva in 1930. . ." and also "The right-hand specimen mounted on the same sheet is recorded under *L. hilarianus*, page 331." Due to the fact that *Muniez 6* includes two plants that represent two different taxa and that the place assigned by Smith for each taxon does not match his descriptions in the actual mounted sheet, we assume that either Smith had a reverse printed photograph or that the collection was remounted on a new sheet with the two plants fixed in different positions. To resolve this situation we designated as lectotype of *L. pseudolinearis* the plant that is mounted on the righthand side of the sheet (assigned by us with the letter B). Furthermore, our interpretation is that *L. pseudolinearis* is a synonym of *L. linearis* because its lectotype is a typical representative plant of the latter taxon and the accompanying plant is clearly identified as *L. gibertianus* var. *gibertianus*.

Representative specimens. *An asterisk indicates a specimen included in this analysis. OTU numbers are in boldface and brackets. ARGENTINA. **Corrientes:** Ituzaingó, Route 34, 13 km SE of Route 12, 11 Oct. 1980, *Schinini & Ahumada 20914* (CTES*) **[6]**; Mercedes, 4 Nov. 1972, *Sánchez 1001* (BA), 4 Nov. 1973, *Burkart 29908* (SI*) **[7]**; Paso de Los Libres, 4 Oct. 1993, *Planchuelo 653* (ACOR*) **[10]**; Ruta 23, 2 km E Río Miriñay, 4 Nov. 1973, *Schinini 7745* (CTES, G, MO, UC); Río Miriñay between Paso de los Libres and Mercedes, 5 Nov. 1973, *Fabris 8608* (LP*) **[9];** Parada Pucheta, 6 Nov. 1936, *Parodi 12301* (BAA); San Martín, Yapeyú, 14 Sep. 1979, *Schinini et al. 18426* (CTES); Santo Tomé, 29 Oct. 1970, *Krapovickas & Cristóbal 16374* (CTES*), 3 Oct. 1993, *Planchuelo 652* (ACOR*) **[15];** Arroyo Guay Grande, 22 Oct. 1975, *Zardini 1083* (LP). **Misiones:** *Birabén 5415* (LP*), 4 Jan. 1906, *Bonpland s.n., herbarium Hauman Merck 126* (SI, plant mounted on the right side of the sheet*); Parada Seis, 20 Oct., *Burkart 19620* (SI; US); Apóstoles, 22 Sep. 1967, *Krapovickas et al. 15477* (CTES* **[23]**, SI, UC); Aero Club, 3 Oct. 1993, *Planchuelo 651* (ACOR*) **[25]**; Cainguás, Puerto Rico, 17 Oct. 1947, *Schwindt 443* (LIL plant C); around Posadas, Dec. 1950, *Spegazzini 10810* (BAF*), 2 Oct. 1911, *Muniez 6* (BAF plant designated as A only* **[32]**; G plant designated as B only); Eldorado, 27 Sep. 1949, *Schwindt 2151* (CTES*; LIL plants A, B, C, D, F, G, H); Puerto Victoria, 12 Nov. 1949, *Schwindt 2831* (CTES plants mounted in the middle of the herbarium sheet); Iguazú, Puerto Istueta km 14, 20 Sep. 1950, *Montes 9285* (LIL*) **[28]**; San Ignacio, 11 Oct. 1946, *Medina 58* (LIL plant C); San Pedro, Arroyo Liso, 18 Sep. 1945, *Bertoni 1929* (CTES* **[31]**, LIL); Santa Ana, 30 Nov. 1909, *Rodríguez 58* (SI, plant mounted on the leaf side of isotype of *L. sanctae-anae*), Nov. 1913, *Rodríguez 58* (BA plant designated as A*, no type of *L. sanctae-anae*); San Ignacio, 4 Feb. 1947, *Montes 878* (BA sheet A plant C, sheet B plant A). BRAZIL. **Río Grande do Sul:** Caçapava do Sul, 21 Nov. 1986, *Guerra et al. 2042* (US*) **[42]**; Porto Alegre, 4 Nov. 1948, *Rambo 37880* (LIL*). PARAGUAY. **Itapúa:** Encarnación, Itacuí, 5 Oct. 1949, *Bertoni 4494* (LIL*) **[44]**. URUGUAY. Independencia, 24 Oct. 1886, *Safford s.n.* (US 920137*). **Montevideo:** Montevideo, *Commerson s.n.* (G* **[48]**; P); Cerro, Oct. 1925, *Herter et al. 454A* (B*; G, US); Cerro Casabo, Sep. 1926, *Herter 454* (B, F, G, GH, LIL* **[49]**, MO, NY, UC).

2. Lupinus gibertianus C. P. Smith, Spec. Lupinorum 13: 206. 1940. TYPE: Uruguay. Montevideo: 20 July 1866, *Gilbert 467* (holotype, K, ACOR photo; isotypes, MO, UMO, US).

Plants annual, 20–70 cm tall. Juvenile plants without basal rosette of leaves, adult plants branching mainly above. Stems 2–7 mm diam., cylindric or somewhat angular and ± hollow or subfistulose in the young branches, strigose; internodes 2–5 cm long. Stipules 4–10 mm long, the free tip lanceolate-caudate, 1.5–4(–5) × 0.5–1.5 mm. Leaves palmately compound with 5 to 9 leaflets; petioles 1.5–8.2 cm long, pubescence as stems; leaflets (15–)20–40(–45) × (3.5–)4–12(–15) mm, when less than 4.5 mm wide no longer than 25 mm, narrowly to broadly oblanceolate, appressed pilose below, glabrous above, with an LSC of 0.60 to 0.90, tips acute to rounded, mucronate. Racemes 4–20 cm long, terminal, but sometimes appearing lateral when the top lateral bud grows rapidly compressing the raceme sideways, with 15 to 45 flowers, scattered. Bracts ovate, 3–4 × 1–2 mm, caducous, the tip attenuate, sericeous dorsally. Bracteoles lanceolate-ovate to linear-lanceolate, 0.8–2 × 0.2–0.4 mm, attached 0.5 mm below the lips of the lateral sinuses of the calyx. Pedicel sericeous, 2–4 mm long at anthesis, 3–5 mm in fruit. Calyx sericeous outside, glabrous within, the base sometimes slightly gibbous above, lip connate 1.5–2.0 mm; lower lip (5.5–)6.5–8.0(–10) × 2–3 mm, normally tridentate, the central tooth (0.2–)1–2 × 0.3–0.4 mm, the two lateral teeth shorter, sometimes obsolete or reduced to a tuft of hairs at the end of the two lateral veins; upper lip 3–6 mm long, bifid, the lobes 2–4 × 1–2 mm. Corolla variable in color, changing from purplish to almost white, without blue tint. Standard petal oblong-ovate to oblong-obovate (7–)8–11 × (4.5–)5–10 mm, clawed, glabrous, appressed 2–4

mm, reflexed 5–8 mm, reflexed/appressed: 1.9—2.5, angle 120–130°. Wings 8–11 mm long including a 1.5–2 mm claw, 4–6 mm wide, lobe above the claw 1–1.5 mm wide. Keel 1.5–4 mm wide in the middle, glabrous, or rarely a few cilia above on the distal half, the angle 90–100°, tip blunt and rounded. Ovules 4 to 8. Legume 3–4 × 0.5–0.7 cm, sericeous. Seeds 3–4 × 2.8 mm, yellowish, covered with very small tan mottling and sparse large tan spots and stripes.

Iconography. Figure 4; Dunn & Planchuelo, 1981: 468, fig. 2; Planchuelo, 1996a: 111, fig. 1.1.

Phenology. Flowering specimens have been collected from early September through December, and fruiting specimens from early October through February.

Habitat. This species shares the same habitat as *L. linearis* and is also found in consolidated dunes (Fuentes & Planchuelo, 2000) and sandy areas with poor vegetation cover.

Distribution. Mainly in eastern Argentina, Uruguay, Paraguay, and southern Brazil.

Discussion. Three varieties of sympatric distribution are identified by the differences in shape and size of the leaflets as major characters, and also by small differences in the free portion of the stipules and the shape and size of the standard petal.

2a. **Lupinus gibertianus** var. **gibertianus**

Lupinus bonplandianus C. P. Smith, Spec. Lupinorum 14: 212. 1940. Syn. nov. TYPE: Argentina. Misiones: June 1821, *Bonpland s.n.* (holotype, P).

Lupinus propedubius C. P. Smith, Spec. Lupinorum 21: 332. 1943. Syn. nov. TYPE: Argentina. Misiones: Grandes malezales de Hibay, 8 Oct. 1886, *Niederlein 1127* (holotype, B lost).

Lupinus sanctae-anae C. P. Smith, Spec. Lupinorum 22: 348. 1944. Syn. nov. TYPE: Argentina. Misiones: Santa Ana, 30 Nov. 1909, *Rodríguez 58* (holotype, DS; ACOR photo, UMO photo; isotypes, LIL, SI—right side of sheet only).

This variety is characterized by short and narrowly oblanceolate leaflets, 15–25 × (3.5–)4–6(–7) mm with an LCS = 0.7–0.9. Free portion of the stipules 1.5–2.5 × 0.5–1 mm. Standard petal 7–8 × 4.5–6 mm.

Iconography. Figure 4B.

Discussion. The holotype of *L. sanctae-anae* (*Rodríguez 58*, DS) and the isotype from LIL are representative of the taxon, but the sheet on which the isotype from SI is mounted includes plants of two different taxa. In this case the plant on the right side of the sheet is the isotype. Another specimen (*Rodríguez 58* from BA) differed from the type by the date of collection, and it is not considered as type; the two plants of different species mounted on the same sheet were identified according to the citations in this paper.

Representative specimens. *An asterisk indicates a specimen included in this analysis. OTU numbers are in boldface and brackets. ARGENTINA. **Chaco:** Resistencia, Campo Alto, 10 Oct. 1948, *Vega 885* (CTES* **[3]**, LIL). **Corrientes:** Mburucuyá, Ea. Santa Teresa, 4 Sep. 1946, *Pedersen 1* (LP, US); Mercedes, between Solari y Mercedes, 8 Oct. 1971, *Carnevali 2583* (CTES*); Paso de Los Libres, Río Miriñay, 4 Nov. 1973, *Schulz 18646* (CTES*) **[8]**; San Cosme, Paso de la Patria, 3 Oct. 1945, *Würth 158* (LIL); San Martín, Tres Cerros, 16 Sep. 1979, *Schinini 18582* (CTES*) **[14]**; Santa Ana, Santa Ana, 14 Nov. 1934, *Parodi 12056* (BAA*); Santo Tomé, Ea. San Francisco, 5 Dec. 1970, *Krapovickas et al. 17195* (BAA*, CTES); Salto Grande, 3 Oct. 1978, *Renvoize 2877* (US*). **Entre Ríos:** Concordia, Río Yuquerí Chico, 13 Oct. 1968, *Cabrera-Sagastegui 19330* (LP*) **[18]. Misiones:** *Montes 14710* (MO), June 1821, *Bonpland s.n.* (P*), 4 Jan. 1906, *Bonpland s.n., herbarium Hauman Merck 126* (SI plants on the middle and left side of the sheet*) **[21]**; Apóstoles, Escuela Agrotécnica, Oct. 1977, *Cabrera et al. 28566* (SI*) **[24]**; Cainguás, Puerto Rico, 17 Oct. 1947, *Schwindt 443* (CTES, LIL plants A, B, D, E); Capiovy, 18 Oct. 1948, *Schwindt 771* (CTES*) **[26]**; Candelaria, Santa Ana, 30 Nov. 1909, *Rodríguez 58* (DS, LIL, SI plant mounted on the right side of the sheet), Nov. 1913, *Rodríguez 58* (BA plant mounted on the right side designated as B*) **[27]**, 17 Sep. 1945, *Montes 1067* (LIL); Mártires, 12 Oct. 1947, *Bertoni 3408* (LIL*); Loreto, 7 Oct. 1946, *Montes 4* (BA); Posadas, 2 Oct. 1911, *Muniez 6* (BAF plant designated as B*; G plant designated as A only), 8 Sep. 1945, *Bertoni 1895* (CTES, LIL); Eldorado, 27 Sep. 1949, *Schwindt 2151* (LIL plant E); Puerto Victoria, 12 Nov. 1949, *Schwindt 2831* (CTES mixed with *L. linearis* in the same sheet, LIL*); San Ignacio, 11 Oct. 1946, *Medina 58* (LIL plants A, B, D, E, F, G, H), 4 Feb. 1947, *Montes 878* (BA sheet A plant B, sheet B plants B, C), 31 Aug. 1949, *Job s.n.* (LP 905476); San Pedro, arroyo Liso, 18 Sep. 1945, *Bertoni 1929* (LIL*). **Santa Fé:** Garay, Cayastá, 3 Nov. 1995, *Planchuelo et al. 817* (ACOR*) **[36]**; San Jerónimo, Is. Campo Rico, 22 Oct. 1977, *Franceschi 59* (SI). URUGUAY. **Montevideo:** Montevideo, 20 July 1866, *Gibert 467* (K*). **Colonia:** Cerro Carmelo, 6 Dec. 1934, *Cabrera 3198* (LP*) **[45]**. PARAGUAY. **Curupayty:** Humaitá Neembucú, 9 Nov. 1978, *Rojas 1470* (G*). **Itapúa:** Encarnación, Sep. 1915, *Hassler 1470* (G; SI*).

2c. **Lupinus gibertianus** var. **reineckianus** (C. P. Smith) Planchuelo & E. Fuentes, comb. nov.

Basionym: *Lupinus hilarianus* var. *reineckianus* C. P. Smith, Spec. Lupinorum 14: 212. 1940. *Lupinus reineckianus* C. P. Smith, Spec. Lupinorum 30: 484. 1945. TYPE: Brazil. Rio Grande do Sul: 1897, *Reineck & Czermak 93* (holotype, K; ACOR photo, UMO photo; isotype, BA).

Lupinus hassleranus C. P. Smith, Spec. Lupinorum 14: 211. Nov. 1940. Syn. nov. TYPE: Argentina. Misiones: San Ignacio, Oct., *Hassler 444* (holotype, G; UMO photo).

Figure 4. A, C. *Lupinus gibertianus* var. *reineckianus* (C. P. Smith) Planchuelo & E. Fuentes. B. *Lupinus gibertianus* var. *gibertianus*. D. *Lupinus gibertianus* var. *berroanus* (C. P. Smith) Planchuelo & E. Fuentes. —A. Habit. —B. Leaf of variety *gibertianus*, adaxial side (drawn from *Planchuelo et al. 817*, ACOR). —C. Leaf adaxial side (drawn from *Planchuelo 656*, ACOR). —D. Leaf of variety *berroanus*, adaxial side (drawn from *Planchuelo 609*, ACOR).

Lupinus niederleinianus C. P. Smith, Spec. Lupinorum 14: 213. 1940. Syn. nov. TYPE: Argentina. Misiones: Campo Evé, 14 Jan. 1887, *Niederlein 1126* (holotype, B lost; isotype, BA, ACOR photo).

Lupinus rubidus C. P. Smith, Spec. Lupinorum 21: 331. 1943. Syn. nov. TYPE: Argentina. Tucumán: Chicligasta, 14 Oct. 1913, *Monetti 1245* (holotype, DS; ACOR photo, UMO photo; isotypes, GH, LIL).

Lupinus aspersus C. P. Smith, Spec. Lupinorum 22: 345. 1944. Syn. nov. TYPE: Argentina. Santa Fé: Chaco Santafecino, Mocoví, 26 Oct. 1903, *Venturi 92* (holotype, DS; ACOR photo, UMO photo; isotypes, BA, BAA, CORD, LIL, US).

Lupinus palmarum C. P. Smith, Spec. Lupinorum 22: 347. 1944. Syn. nov. TYPE: Argentina. Chaco: Las Palmas, Oct. 1917, *Jörgensen 2139* (holotype, DS; ACOR photo, UMO photo; isotypes, LIL, SI).

This variety is characterized by its oblanceolate leaflets, 28–38 × (6–)7–8.5(–9) mm with an LSC = 0.80–0.90. Free portion of the stipules 3–4(–5) × 1(–1.5) mm. Standard petal 10–11 × 9–10 mm.

Iconography. Figure 4A, C.

Discussion. *Venturi 92* was cited by C. P. Smith as the holotype of *L. aspersus* (DS); earlier the same author (Spec. Lupinorum 21: 331, 1943) cited the specimen as *L. hilarianus* (US). Both specimens are similar and represent the taxon that we treat here as *Lupinus gibertianus* var. *reineckianus*.

Representative specimens. *An asterisk indicates a specimen included in this analysis. OTU numbers are in boldface and brackets. ARGENTINA. **Chaco:** Río Tragadero, 27 Sep. 1942, *Schulz 3530* (CTES*); Bermejo, Las Palmas, Oct. 1917, *Jörgensen 2139* (DS; SI* **[1]**); Primero de Mayo, Margarita Belén, 7 Nov. 1947, *Aguilar s.n.* (LIL 211346). **Corrientes:** Bella Vista, 5 Oct. 1976, *Fernández Velasco s.n.* (BA 68959); Capital, Parada Medina, 28 Sep. 1975, *Schinini & Martínez Crovetto 12213* (G); Escuela de Agricultura, 5 Oct. 1967, *Arbo 68* (BAA, CTES, MO); Prefectura, 30 Oct. 1966, *Krapovickas 1258* (CTES); Perichón, 29 Sep. 1974, *Krapovickas et al. 26450* (CTES* **[4]**, LIL); General Paz, Puissoye, 26 Oct. 1945, *Ibarrola 3618* (LIL*); Itatí, 8 Oct. 1964, *Pedersen 7073* (B, LP, LSR, RNG, US); Ituzaingó, 30 Sep. 1993, *Planchuelo 618 B* (ACOR*); Ea. Santa Tecla, *Schwarz 8048* (LIL*); Mburucuyá, Ea. Santa Teresa, 8 Oct. 1954, *Cabrera 11642* (US); San Cosme, Paso de La Patria, 21 Feb. 1984, *Schinini & Martínez Crovetto 22785* (LIL*) **[11]**, 25 Sep. 1988, *Krapovickas 42745* (BA*, G); road to Paso de La Patria, 29 Sep. 1993, *Planchuelo 611* (ACOR*) **[13]**; San Luis del Palmar, Route 5 and Riachuelo, 5 Oct. 1975, *Cristóbal 1331* (G); San Roque, Ea. Caaguazú road to Tacuaritas, 25 Oct. 1996, *Arbo et al. 6855* (LIL); Santo Tomé, Garruchos, 20 Sep. 1974, *Krapovickas 25780* (LIL*). **Entre Ríos:** Concordia, Sep. 1917, *Alazraqui s.n.* (BA 63399), 8 Nov. 1965, *Burkart 25960* (US*) **[17]**; camino al INTA, 4 Oct. 1993, *Planchuelo 656* (ACOR); Gualeguaychú, Paranacito, Nov. 1917, *Hauman s.n.* (BA 63397), Nov. 1931, *Daguerre s.n.* (BA 11965); Brazo Largo, 23 Oct. 1980, *Troncoso & Bacigalupo 2880* (US*) **[20]**; Médanos, *Parodi 9462* (BAA). **Misiones:** Campo Evé, 14 Jan. 1887, *Niederlein 1126* (BA*) **[22]**; Libertador General San Martín, Puerto Mineral, 24 Aug. 1950, *Schwarz 10685* (LIL*) **[29]**; San Ignacio, Oct., *Hassler 444* (G*) **[30]**, 4 Feb. 1947, *Montes 878* (BA sheet A plant A); Menocchio, 12 Oct. 1945, *Schwarz 1256* (LIL); Santo Pipó, 3 Oct. 1947, *Schwarz 4874* (CTES, LIL), 23 Sep. 1948, *Schwarz 6143* (CTES, LIL); General Roca, 7 Oct. 1948, *Schwarz 6311* (LIL). **Santa Fe:** Capital, San José del Rincón, 5 Oct. 1911, *Álvarez 868* (LIL*); Colastiné, 8 Nov. 1946, *Álvarez 924* (LIL*) **[43]**; access to Túnel Subfluvial Hernandarias, 3 Nov. 1995, *Planchuelo 812* (ACOR*) **[33]**; Garay, Cayastá, 18 Oct. 1980, *Perrone s.n.* (BA 70851); General Obligado, Mocoví, 26 Oct. 1903, *Venturi 92* (BA, BAA* **[37]**, CORD, DS, LIL, US); Las Colonias, Esperanza, 15 Nov. 1946, *Huidobro 3262* (LIL*). **Tucumán:** Chicligasta, 14 Oct. 1913, *Monetti 1245* (DS, LIL* **[38]**); Monteros, Río Monteros, 12 Oct., *Killip 39509* (US). BRAZIL. **Rio Grande Do Sul:** 1897, *Reineck & Czemark 93* (BA* **[41]**, K). URUGUAY. **Colonia:** Artilleros, 17 Dec. 1943, *Bartlett 21221* (US*) **[46]**.

2d. Lupinus gibertianus var. **berroanus** (C. P. Smith) Planchuelo & E. Fuentes, comb. et stat. nov. Basionym: *Lupinus berroanus* C. P. Smith, Spec. Lupinorum 14: 213. 1940. TYPE: Uruguay. Salto: 4 Nov. 1902, *Berro 2775* (holotype, K H 82/77–5; ACOR photo, UMO photo).

This variety is characterized by the leaflet size, 30–45 × 10–13(–15) mm with an LSC = 0.60–0.79, which represents the maximum expression of leaflet width independently of leaf and plant size. Free portion of the stipules 3–4 × 1.5 mm. Standard petal 8–10 × 7–9 mm.

Iconography. Figure 4D.

Representative specimens. *An asterisk indicates a specimen included in this analysis. OTU numbers are in boldface and brackets. ARGENTINA. **Chaco:** Primero de Marzo, Colonia Benitez, *Bacigalupo et al. s.n.* (BAA 9504*) **[2]**. **Corrientes:** Capital, Camino a Santa Ana, 29 Nov. 1993, *Planchuelo 609* (ACOR*) **[5]**; Concepción, Carámbola, 17 Dec. 1974, *Burkart et al. 30888* (US); Empedrado, 26 Sep. 1971, *Krapovickas et al. 19958* (CTES*); General Paz, 15 Oct. 1945, *Ibarrola 3523* (LIL*); Ituzaingó, 30 Sep. 1993, *Planchuelo 618 A* (ACOR*), 10 Oct. 1949, *Schwarz 8206* (LIL*); San Cosme, Paso de La Patria, 13 Oct. 1982, *Schinini & Martínez Crovetto 22785* (CTES*), 25 Sep. 1988, *Krapovickas 42745* (LIL*) **[12]**; Saladas, Laguna Soto Saladas, 26 Sep. 1944, *Schwarz 59* (LIL*). **Entre Ríos:** Concordia, 13 Nov. 1956, *Ruiz Leal 18349* (RL*) **[16]**; crossroads Rutas 14 y 22, 4 Oct. 1993, *Planchuelo 655* (ACOR*) **[19]**; INTA Concordia, 4 Oct. 1993, *Planchuelo 658* (ACOR*). **Misiones:** Apóstoles, 10 km of Azara, 31 Aug. 1974, *Arbo et al. 2300* (CTES*). **Santa Fé:** Capital, La Guardia, 19 Nov. 1946, *Huidobro 3069* (LIL); Guadalupe, 21 Nov. 1946, *Huidobro 3411* (LIL*); Castellanos, Rafaela, 15 Nov. 1946, *Huidobro 3423* (CTES*) **[34]**; Garay, Cayastá, 3 Nov. 1995, *Planchuelo 816* (ACOR*) **[35]**. **Tucumán:** Leales, Los Gómez, Río Salí, Nov. 1919, *Venturi 630* (DS, LP*); Monteros, Río Romero, 22 Nov. 1903, *Lillo 3281* (LIL)* **[39]**; Acheral, 500 msm, 11 Nov. 1923, *Venturi 2485* (BA, LIL* **[40]**, US). URUGUAY. **Salto:** Salto, 4 Nov. 1902, *Berro 2775* (K*) **[50]**. **Colonia:** Colonia, 11 Nov. 1919, *Castellanos s.n.* (BA 56695*); Riachuelo, Oct. 1949, *Fabris 37* (LP*) **[47]**.

Acknowledgments. The authors are indebted to the curators of the herbaria cited and to the botanists of the Smithsonian Institution and the Royal Botanic Gardens, Kew, for the kind attention received. Also special thanks are given to J. Michael Lock (K) for reviewing the manuscript and to Victoria C. Hollowell and Amy McPherson (MO) for their invaluable help during the editing of the paper. This research was partially funded by CONICOR, FONCYT, Fundación Antorchas, and SECYT of the Universidad Nacional de Córdoba, Argentina.

Literature Cited

Crisci, J. V. & M. F. López Armengol. 1983. Introducción a la Teoría y Práctica de la Taxonomía Numérica. O.E.A., Washington, D.C.

Dunn, D. B. 1984. Cytotaxonomy and distribution of New World lupin species. Proc. 3rd International Lupine Conference: 68–85. La Rochelle, France.

——— & A. M. Planchuelo. 1981. *Lupinus heptaphyllus* (Velloso) vs. *Lupinus hilarianus* Bentham. Taxon 30: 464–470.

Fuentes, E. & A. M. Planchuelo. 1997. Sterol and fatty acid patterns in wild and cultivated species of *Lupinus* (Leguminosae). Z. Naturf. 52c: 9–14.

——— & ———. 2000. Wild lupins as pioneers of riverside sand banks. Pp. 316–319 *in* E. van Santen, M. Wink, S. Weissmann & P. Roemer (editors), Lupin, an Ancient Crop for the New Millennium. Proc. 9th International Lupin Conference. Auburn University, Montgomery, Alabama.

Merino, E. F., E. Fuentes & A. M. Planchuelo. 2000. Phytochemical characterisation of lupin species of South America. Pp. 291–293 *in* E. van Santen, M. Wink, S. Weissmann & P. Roemer (editors), Lupin, an Ancient Crop for the New Millennium. Proc. 9th International Lupin Conference. Auburn University, Montgomery, Alabama.

———, D. Maestri & A. M. Planchuelo. 1999. Chemotaxonomic evaluation of leaf alkanes in species of *Lupinus* (Leguminosae). Biochem. Syst. Ecol. 27: 297–301.

Planchuelo, A. M. 1978. A Monograph of *Lupinus* for Argentina. Ph.D. Dissertation, University of Missouri–Columbia. Univ. Microfilm Inter. 39/10B, Order N1 7906915: 179.

———. 1982. Revisión bibliográfica del género *Lupinus*, Literature review of the genus *Lupinus*. Lupin Newslett. 4: 37–39.

———. 1994a. Wild lupin distribution and its implication as germplasm resources. Pp. 65–69 *in* J. M. Neves Martins & M. L. Beirao Da Costa (editors), Advances in Lupin Research. ISA-Press, Lisboa, Portugal.

———. 1994b. Quinolizidine alkaloid profiles of wild lupines from South America. The Science of Legumes (1): 81–85. Finland.

———. 1996a. Relationship between South American and European species of *Lupinus*. Pp. 109–116 *in* B. Pickersgill & J. M. Lock (editors), Advances in Legume Systematics 8: Legumes of Economic Importance. Royal Botanic Gardens, Kew.

———. 1996b. A new species of *Lupinus* (Fabaceae: Lupininae) from southeastern Brazil. Brittonia 48: 263–265.

——— & D. B. Dunn. 1984. The simple leaved lupines and their relatives in Argentina. Ann. Missouri Bot. Gard. 71: 92–103.

——— & ———. 1989. Two new species of the *Lupinus lanatus* complex. Ann. Missouri Bot. Gard. 76: 303–309.

Planchuelo-Ravelo, A. M. 1984. Taxonomic studies of *Lupinus* in South America. Proc. 3rd International Lupine Conference: 40–53. La Rochelle, France.

———. 1991. Flower morphology of *Lupinus gibertianus* complex and its relation with cultivated species. Proc. VI International Lupin Conference: 366–372. Temuco–Pucón, Chile.

———, L. Witte & M. Wink. 1993. Quinolizidine alkaloid profiles of South American lupins: *Lupinus linearis* and the *Lupinus gibertianus* complex. Z. Naturf. 48c: 702–706.

Rohlf, F. J. 1992. NTSYS-pc. Numerical Taxonomy and Multivariate Analysis System (vers. 1.70). Exeter Software, New York.

A New Species of *Kostermanthus* (Chrysobalanaceae) from Sarawak, Malaysia

Ghillean T. Prance

National Tropical Botanical Garden, 3530 Papalina Road, Kalaheo, Hawaii 96741, U.S.A.

ABSTRACT. *Kostermanthus robustus* is described from the Malaysian state of Sarawak in Borneo. This is only the third species in this genus, which is distinguished from other Malesian genera of Chrysobalanaceae by the stamens, which are united into a ligule as in the Neotropical genus *Acioa* and the African genus *Dactyladenia.*

Key words: *Acioa,* Borneo, Chrysobalanaceae, *Kostermanthus,* Malaysia, Sarawak.

A review of material of Chrysobalanaceae for a monograph for *Species Plantarum* revealed a new species of *Kostermanthus* that had been previously overlooked. This adds a third species to this small genus, which is distinguished from other Malesian genera by the stamens, which are united into a ligule. The material described here had been identified previously as *Acioa percoriacea* of Kostermans (1965), which was described from a single sterile collection that does not match the new species described here. *Acioa percoriacea* has a pubescent leaf undersurface, more pronounced venation and two large, prominent glands at the intersection of the petiole and lamina, and is quite different from the material described here as *K. robustus.* Kostermans placed the other two species of *Kostermanthus* in *Acioa* because that Neotropical genus shares the staminal ligule. However, *Acioa* and *Kostermanthus* differ in many other characters of both the flowers and the fruit (see Prance & White, 1988). *Kostermanthus robustus* has a much more robust inflorescence and flowers with a solid campanulate receptacle 5–6 mm long as well as larger and thicker leaves than its two congenerics.

Kostermanthus robustus Prance, sp. nov. TYPE: Malaysia. Sarawak: First Division, Sabal Sawmill Area, Sabal Forest Reserve, 70th Mile, Serian–Simanggang Road, Simunjan, 13 Oct. 1974 (fl), *I. Paie & Azahari S35748* (holotype, K; isotypes, A, L, MO). Figure 1.

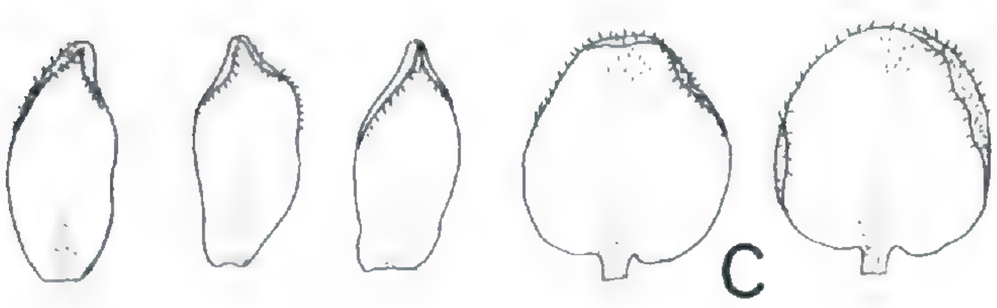
Species *K. heteropetalo* affinis sed ramulis, inflorescentiis robustioribus, foliis coriaceis majoribus, receptaculis 5–6 (haud 3–4) mm longis intus solidis differt.

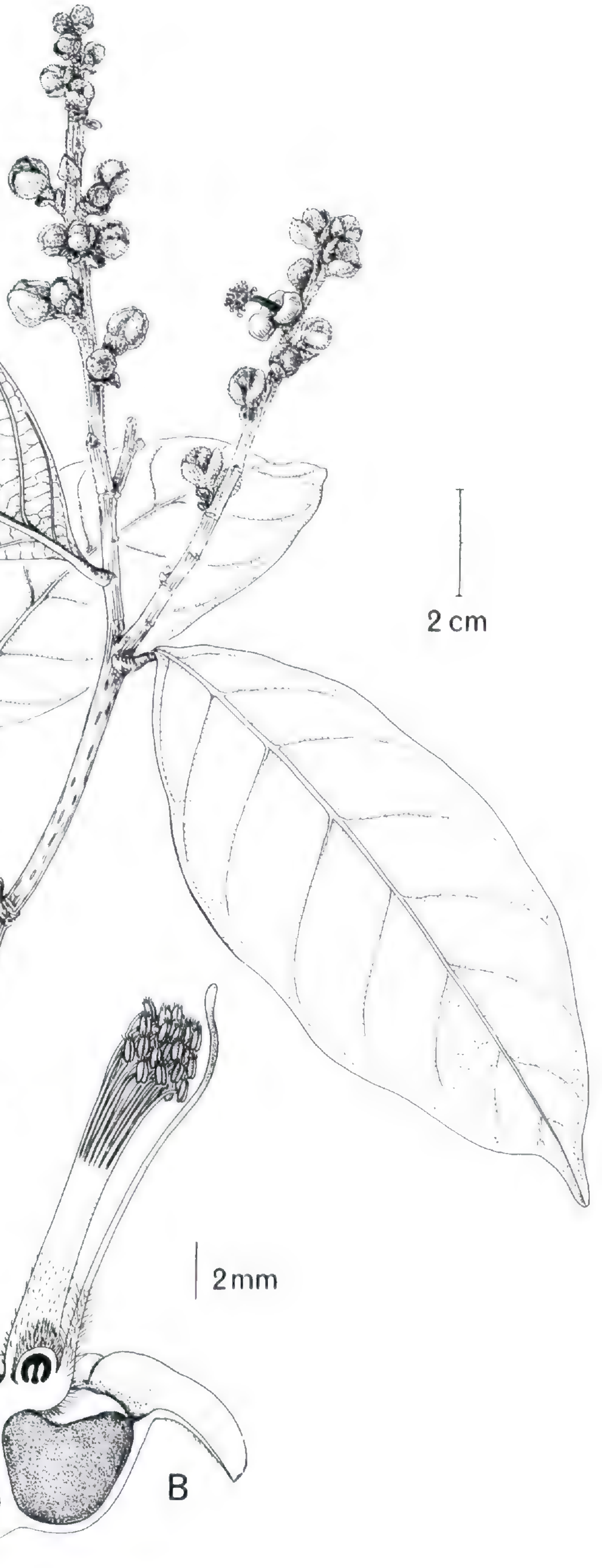
Trees to 30 m tall, the young branches glabrous, with long thin lenticels. Stipules early caducous (not seen); petioles 6–10 mm long, glabrous, usually eglandular or with 2 glands on lower surface near junction with lamina. Leaf lamina thickly coriaceous, oblong-elliptic, 9–22 × 4–7 cm, acute or bluntly acuminate at apex, cuneate or rounded at base, glabrous on both surfaces, minutely papillose on venation of both surfaces giving a bead-like appearance; primary veins 8–13 pairs, plane above, prominulous beneath; midrib slightly prominulous above toward base, plane near apex, prominent and glabrous beneath. Receptacle broadly campanulate and slightly gibbous, 5–6 mm long, solid within, sericeous-tomentose on exterior, tomentose within; calyx lobes unequal, 5–9 mm long, tomentose on exterior, tomentose within on upper portion. Petals dark red, unequal, with 2 large and slightly unguiculate, 9 × 7 mm, and 3 smaller ones not clawed, 7 × 3.5 mm, 2 of the smaller ones enveloping the staminal ligule. Stamens ca. 45, united into a unilateral ligule for 2/3 of length, 13–14 mm long, tomentellous on lower portion, glabrous above; anthers pubescent. Ovary densely pilose. Style densely pilose around base, glabrous on upper 2/3. Young fruit ovoid; exocarp glabrous, crustaceous; mesocarp thick and fibrous; endocarp thin and bony, sparsely arachnoid pubescent within.

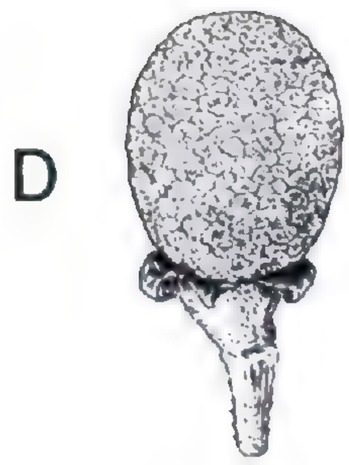
Habitat. Hill slopes in mixed Dipterocarp forest to 200 m and in heath forest up to 700 m.

This species differs from *Kostermanthus heteropetalus* in the much more coriaceous and larger leaves, the more robust and thicker inflorescence with larger flowers, the solid center of the receptacle, and the less unguiculate petals that are colored deep red. In *K. heteropetalus* the petals are white tinged pink.

Paratypes. MALAYSIA. **Sarawak:** Semengoh Arboretum, Tree No. 1099, 21 Nov. 1978 (fl), *I. Paie & Bernard S38000* (K, KEP, L, MO, SAN), 24 Nov. 1961 (young fr), *Galau S15729* (B, K, L, S, M), 1961 (fl bud), *Rosli S14959* (same tree as S15729) (A, B, K, L, NB, S); 4th Division, Bukit Mentagai, Bak-Tisam, Marudi, 11 May 1965 (fl), *Sibat ak Luang S23295* (A, BO, K, L, SAN, SING).







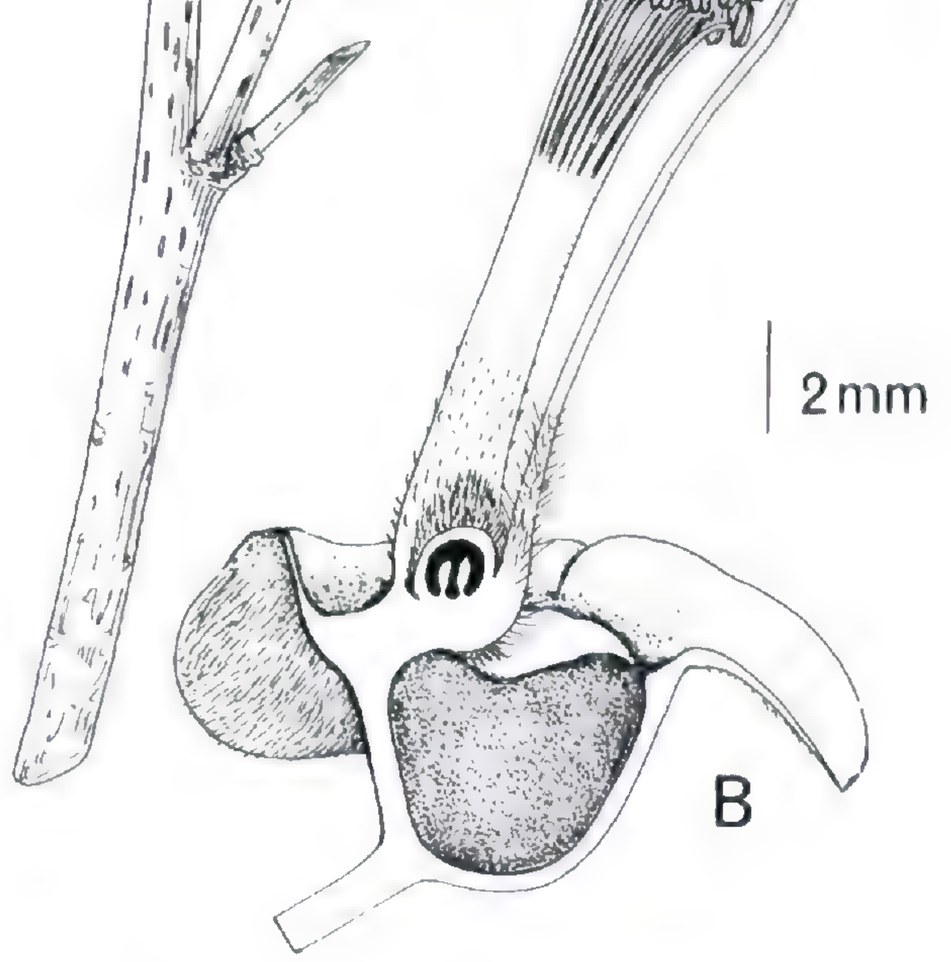


Figure 1. *Kostermanthus robustus* Prance. —A. Habit (*Paie & Azahari S35748*, from holotype). —B. Half flower (*Paie & Azahari S35748*). —C. Petals (*Paie & Azahari S35748*). —D. Young fruit (*Galau S15729*, same scale as A). Drawn by Margaret Tebbs.

Key to the Species of *Kostermanthus*

1a. Leaves coriaceous; petioles 6–12 mm long; receptacle broadly campanulate.
  2a. Leaves thinly coriaceous; receptacle 2–3 mm long, hollow within . . . . . *K. heteropetalus* (Scortechini ex King) Prance
  2b. Leaves thickly coriaceous; receptacle 5–6 mm long, solid within . . . . *K. robustus* Prance
1b. Leaves chartaceous; petioles 2–3 mm long; receptacle slender cylindrical, 5 mm long . . . . . *K. malayanus* (Kostermans) Prance

Acknowledgments. I thank Cynthia Sothers for assistance with work on Chrysobalanaceae and the Leverhulme Trust for an Emeritus Fellowship in support of this work. I also thank the Keeper of the Herbarium of the Royal Botanic Gardens, Kew, where the material described was studied and the National Tropical Botanical Garden for the position as McBryde Professor to carry out my research work.

Literature Cited

Kostermans, A. J. G. H. 1965. The genus *Acioa* Aublet (Rosaceae–Chrysobalanoideae) in Malesia. Reinwardtia 7: 47–61.

Prance, G. T. & F. White. 1988. The genera of Chrysobalanaceae: A study in practical and theoretical taxonomy and its relevance to evolutionary biology. Philos. Trans. Roy. Soc. B. 320: 1–184.

Sectional Names in *Carex* (Cyperaceae) for the Flora of North America

A. A. Reznicek

University of Michigan Herbarium, North University Building, Ann Arbor, Michigan 48109, U.S.A. reznicek@umich.edu

ABSTRACT. Review of the sectional nomenclature for the treatment of *Carex* for the *Flora of North America* disclosed a number of deficiencies in the currently accepted sectional names. Three sectional names needed typification, including *Carex* sect. *Firmiculmes*, lectotypified with *C. geyeri*, *Carex* sect. *Inflatae*, lectotypified with *C. breweri*, and *Carex* sect. *Leptocephalae*, lectotypified with *C. leptalea*. Several earlier names than those in use in recent monographs were also discovered, including *Carex* sect. *Racemosae* for *Carex* sect. *Microrhynchae* (*Carex* sect. *Atratae*), *Carex* sect. *Thuringiaca* for *Carex* sect. *Glaucae*, and *Carex* sect. *Dornera* for *Carex* sect. *Callistachys*. Two sectional names in common use, *Carex* sect. *Hispidae*, sect. nov., and *Carex* sect. *Longicaules*, sect. nov., were not published with Latin descriptions nor reference to previously published descriptions and are here validly published and precisely circumscribed. Finally, two new sections are proposed to accommodate North American species that did not fit adequately into existing sections. These are *Carex* sect. *Glaucescentes*, sect. nov., for four species of large, glaucous clump-forming wetland sedges with papillose perigynia and *Carex* sect. *Hirtifoliae*, sect. nov., a monotypic section for *C. hirtifolia*, a distinctive, pubescent-leaved forest understory species with long-beaked perigynia with nerveless faces.

Key words: *Carex*, Cyperaceae, North America, sections.

Sectional nomenclature is one of the more thankless aspects of writing floras and monographs. Section names can be quite useful for understanding large genera and especially as a learning aid. They are commonly used in *Carex* L., so having stable sectional names is important. Use of formal sectional names by early authors was quite erratic, and there are no modern indices to sectional names. Finding the oldest names and achieving stability is thus a difficult task.

Mackenzie's (1931, 1935) monumental monograph is the base for work on North American *Carex*. However, there are many changes needed for sectional names. Mackenzie, like most of his contemporaries, was not fastidious about making sure that his sectional names were validly published at the rank of section. Furthermore, he was eccentric in only utilizing sectional names based on specific epithets, which considerably distorted his sectional nomenclature. Fortunately, Egorova (1999) did caricologists worldwide a tremendous and much appreciated service by producing a modern synthesis of sectional nomenclature and thoroughly typifying sectional names in her *Carex* monograph for the former Soviet Union. Many of these sections also occur in North America, but there are a number of sections in the North American flora that are not present in Eurasia. Sectional names for some of these need lectotypification so that all sectional names used in the *Flora of North America* can be properly typified. In a few cases, earlier names than ones used by Egorova have also been found. All these are documented here. One of the major sources of earlier sectional names in *Carex* is Don (1830), as noted by Tucker (1987). Heuffel (1858) [1859] also contained validly published sectional names. Some sectional names used by L. H. Bailey in his "A preliminary synopsis of North American *Carex*" (Bailey, 1886) were actually first published in slightly earlier works to which Bailey contributed, such as Coulter's *Manual of the Botany of the Rocky Mountain Region* (Bailey, 1885) and thus predate Christ's (1885 [14 Jan. 1886]) *Nouveau Catalogue des Carex d'Europe*, another major source of names at sectional rank for sections occurring also in Europe.

Mackenzie (1935) published a few sectional names posthumously without a Latin description. Although these have been in common use, they need validation, and this is also done here. Finally, some primarily North American species or groups of species that have up to now been subsumed into Old World sections or into very broadly defined sections are here acknowledged to be distinctive and are also given sectional names.

SECTIONAL NAMES NEEDING LECTOTYPIFICATION

Carex sect. **Firmiculmes** (Kükenthal) Mackenzie, N. Amer. Flora 18: 221. 1935. *Carex* subsect.

Firmiculmes Kükenthal, in A. Engler, Pflanzenr., 20[IV, 38]: 96. 1909. LECTOTYPE (here designated): *Carex geyeri* Boott, Trans. Linn. Soc. London 20(1): 118. 1846.

Kükenthal (1909) included *Carex geyeri, C. multicaulis* L. H. Bailey, and *C. phyllostachys* C. A. Meyer in his subsection *Firmiculmes*. Mackenzie (1935) included only *C. geyeri* and *C. multicaulis* when he raised the subsection to sectional rank, explicitly excluded the Eurasian *C. phyllostachys*, and indicated that it was composed of "two dry ground species, in the western part of the United States, extending into southwestern Canada." Both *C. geyeri* and *C. multicaulis* fit Kükenthal's and Mackenzie's descriptions fully, and *C. geyeri* is the more common and widespread species. More recently, a third species, *C. tompkinsii* Howell (1961), was described as a very localized California endemic closely related to *C. multicaulis*.

Carex sect. **Inflatae** Kükenthal, in A. Engler, Pflanzenr., 20[IV, 38]: 96. 1909. LECTOTYPE (here designated): *Carex breweri* Boott, Ill. Carex, part 4.142, t. 455. 1867.

Kükenthal (1909) included two western North American alpine species, *Carex breweri* and *C. engelmannii* L. H. Bailey in this section, as did Mackenzie (1931). Both species are very similar and fit the sectional description fully. *Carex breweri* is the more common species. *Carex subnigricans* Stacey (1939), another western North American alpine, has also been described in this section.

Carex sect. **Leptocephalae** L. H. Bailey, Proc. Amer. Acad. Arts 22: 131. 1886. LECTOTYPE (here designated): *Carex polytrichoides* Muhlenberg ex Willdenow, Sp. Pl. 4: 213. 1805.

Bailey (1886) included four species in his small section *Leptocephalae*: *Carex leptalea* Wahlenberg (as *C. polytrichoides*), *C. microglochin* Wahlenberg (by error, through a misunderstanding of the identity of *C. lyonii* Boott), *C. anthoxanthea* J. Presl & C. Presl (as *C. leiocarpa* C. A. Meyer), and *C. circinata* C. A. Meyer. *Carex anthoxanthea* and *C. circinata* are very similar, and have long been put into section *Circinatae* Meinshausen. Bailey's brief sectional description appears to have been drawn largely from *C. leptalea*, and it is logical to typify his name with this species.

Sectional Names Predating Those Used by Egorova (1999)

Carex sect. **Racemosae** G. Don, in Loudon, Hort. Brit. 376. 1830. LECTOTYPE (here designated): *Carex atrata* L., Sp. Pl. 976. 1753.

The only other species included by Don in this section is *Carex bicolor* Allioni. Both *C. bicolor* and *C. atrata* fit the brief sectional description equally well. Lectotypification with *C. bicolor* would, however, displace the name *Carex* sect. *Bicolores* (Tuckerman ex L. H. Bailey) Rouy, which will be recognized in the *Flora of North America*. As the familiar name *Carex* sect. *Atratae* has already been displaced with the unfamiliar name *Carex* sect. *Microrhynchae* by Egorova (1999), it seems the lesser of two evils to typify *Carex* sect. *Racemosae* with *C. atrata*. Some authors, including Egorova (1999), do, however, place *C. bicolor* in the same section as *C. atrata* and its relatives. The typification proposed here thus has no impact on the name for the broadly conceived section, but allows people who recognize section *Bicolores* to continue to do so under the familiar name.

Egorova (1999) used the later *Carex* sect. *Microrhynchae* (Drejer) L. H. Bailey in Coulter (Man. Bot. Rocky Mt. 379. 1885, Lectotype designated by Egorova: *Carex atrata*) for the name of this section. She dated the section from Bailey (1886), but believed that *Carex* sect. *Atratae* (Heuffel) Christ, Bull. Soc. Roy. Bot. Belgique 24: 15. 14 Jan. 1886 "1885," used throughout North American Cyperaceae literature and also by Chater (1980) in *Flora Europaea*, was a nomen nudum.

Carex sect. **Thuringiaca** G. Don, in Loudon, Hort. Brit. 376. 1830. TYPE: *Carex thuringiaca* Willdenow, Sp. Pl. 4: 250. 1805.

Egorova (1999) used the later name *Carex* sect. *Glaucae* (Ascherson) Rouy (Fl. France 13: 491. 1912. Type: *C. glauca* Scopoli, Fl. Car. Ed. 2, 2: 223. 1772). Both *Carex thuringiaca* and *C. glauca* are long abandoned synonyms of *C. flacca* Scheber, Spic. Fl. Lips.178. 1771. Mackenzie (1931) placed *Carex flacca* in *Carex* sect. *Pendulinae* (Fries) Mackenzie, a much later name.

Carex sect. **Dornera** Heuffel, Verh. Zool. Bot. Ges. Wien 8: 217. 1858. TYPE: *Carex pyrenaica* Wahlenberg, Kongl. Vetensk. Acad. Nya Handl. 24: 139. 1803.

Egorova (1999) used the later name *Carex* sect. *Callistachys* (Heuffel) Mackenzie, N. Amer. Flora 18: 26. 1931, also with *C. pyrenaica* as the type.

Mackenzie Sectional Names Needing Validation With a Latin Description

Latin descriptions or diagnoses were required for valid publication of new names starting 1 January 1935. New sectional names in those parts of Mackenzie's monograph published in 1935, however, lack Latin descriptions. Those to be used in the *Flora of North America*, *Carex* "section *Hispidae*" and *Carex* "section *Longicaules*," both in subgenus *Carex*, are here validated.

Mackenzie's (1931, 1935) monograph was published in a number of installments. Parts 1 to 3 (pp. 1–168) were published during 1931, except for pages 11–20. Parts 4 to 7 (pp. 169–478) were published during 1935. Pages 11–20, the conspectus and key to the sections, although included with part one, were published later and have a 1935 date on the running head. Some copies of Mackenzie (1931) have an unnumbered page inserted after page 10 with the note "Pages 11–20, constituting a conspectus of the sections of the genus *Carex* and an artificial key to these sections, will be issued with a later Part of this volume." Therefore, although all sectional names have English descriptions on pages 11–20 of part 1, these are not validly published, as the publication date was 1935, not 1931.

Carex sect. **Hispidae** Mackenzie ex Reznicek, sect. nov. TYPE: *Carex spissa* L. H. Bailey, Proc. Amer. Acad. Arts 22: 70. 1886.

Cespitosae vel coloniales, rhizomatibus crassis, brevis. Culmi 60–200 cm alti; basi vaginis coriaceis, atrofuscis. Folia 3–12, coriacea, glabra, glauca; vaginis reticulatim fissis. Inflorescentiae 20–70 cm longae, erectae; spicis 5–12(–20), ascendentibus, terminalibus staminatis, lateralibus pistillatis, staminatis, vel androgynis; bracteis infimis evaginatis vel brevivaginatis. Squamae pistillatae lanceolatae, coriaceae, conspicue aristatae. Perigynia glabra vel hispidula, ovoidea vel obovoidea, interdum brevirostra. Stigmata 3.

Densely colonial from very thick short rhizomes; basal sheaths leathery, dark brown. Culms apparently lateral central, 60–200 cm. Leaves coriaceous, 3 to 12, V-shaped in cross section, glabrous, glaucous; sheath fronts membranous or coriaceous, prominently nerved and becoming ladder-fibrillose. Inflorescences 20–70 cm long with 5 to 12 (20) spikes, occasionally up to 3 per node, terminal spikes staminate, lateral spikes pistillate or the distal 1 to 5 staminate or sometimes androgynous, sessile or the distal short peduncled, stiffly erect; proximal bracts leaf-like, sheathless or short-sheathing, exceeding the inflorescence. Pistillate scales coriaceous, lanceolate, conspicuously awned. Perigynia ascending to spreading, ovoid to narrowly ovoid to obovoid, ellipsoid to flattened-ellipsoid or ± compressed-trigonous in cross section, faintly nerved, pale brown, reddish brown dotted, glabrous to hispidulous, tapering to the apex or contracted to a short erose or ± entire beak, stigmas 3.

Species Included:

1. *Carex pringlei* L. H. Bailey, Bot. Gaz. 17: 151. 1892.
2. *Carex spissa* L. H. Bailey, Proc. Amer. Acad. Arts 22(1): 70. 1886.

Mackenzie (1935) recognized this section, but provided only an English description. He included four species, *Carex spissa*, *C. ultra* L. H. Bailey, *C. seatoniana* L. H. Bailey, and *C. pringlei*, in North America (including Mexico) and alluded to several other Asian and European species. More recent authors (Hermann, 1974) recognized only two North American species, *C. pringlei* and *C. spissa*, with three varieties encompassing Mackenzie's other species. Plants of this section are very robust, broad-leaved plants, 60–200 cm tall, of stream banks, wet depressions, and marshes in areas with hot and dry climates.

Kükenthal placed *Carex spissa* and *C. pringlei* in his section *Trachylaenae* (Drejer) L. H. Bailey. The European and Asian species alluded to by Mackenzie as belonging in this section are thus presumably all the other species included by Kükenthal in section *Trachylaenae*, with the exception of *C. flacca*, which Mackenzie placed in his section *Pendulinae* (Fries) Mackenzie. These Eurasian taxa were *C. setigera* D. Don (including *C. schlangintweitiana* Boeckeler), *C. inanis* Kunth, and *C. hispida* Willdenow. Except for *C. hispida*, these species are all very different from *C. spissa* and *C. pringlei*, in being much shorter, with much narrower leaves, narrower spikes, and long-sheathing bracts. They are also high-elevation species of the central and southern Asian mountains, especially the Himalayas. These Eurasian species are explicitly excluded from this section as here conceived. The Mediterranean *Carex hispida*, however, though long-rhizomatous, is similar to *C. spissa* and *C. pringlei* in some features, and may well, with further research, turn out to belong in this section. We can probably assume that Mackenzie (1935) based his "section *Hispidae*" actually on *C. hispida*, rather than on the misapplication of *C. hispida* to *C. spissa* found in some early North American literature, even though *C. hispida* is not explicitly mentioned. But because this section, as circumscribed here, is

entirely New World, *C. spissa* is designated as the type.

Carex sect. **Longicaules** Mackenzie ex Reznicek, sect. nov. TYPE: *Carex longicaulis* Boeckeler, Flora 65: 62. 1882.

Dense vel laxe cespitosae, rhizomatibus brevis. Culmi 15–110 cm alti; basi vaginis purpureis vel fuscis. Folia 5–12, glabra, scabra, vel pubescentia. Inflorescentiae 1.1–12 cm longae, erectae; spicis 2–5, erectis, terminalibus staminatis vel gynaecandris, lateralibus pistillatis, sessilibus vel brevipedunculatis; bracteis infimis brevivaginatis vel evaginatis. Squamae pistillatae ovatae, acutae vel cuspidatae. Perigynia glabra vel pubescentia, ovoidea vel obovoidea, in rostrum brevidentatulum contractum. Stigmata 3.

Densely to loosely caespitose from short to slightly elongate rhizomes, basal sheaths reddish purple to brown. Culms central, 15–110 cm. Leaves 5 to 12, glabrous, scabrous, or pubescent; sheath fronts membranous, reddish brown dotted or tinged or stramineous, pubescent, scabrous, or glabrous. Inflorescences 1.1–12 cm long, with 2 to 5 spikes, the terminal staminate or gynaecandrous, the lateral pistillate, sessile or short-peduncled; distal bracts leaf-like, shorter than to exceeding the inflorescence, short-sheathing. Pistillate scales ovate, acute or cuspidate. Perigynia ascending, ovoid or obovoid, trigonous, the faces 3- to 7-nerved, green, glabrous or finely pubescent, tapering to a short, bidentulate beak. Stigmas 3.

Species Included:

1. *Carex anisostachys* Liebmann, Mexic. Halvgr. 78. 1850.
2. *Carex ciliaris* Fernald, Proc. Amer. Acad. Arts 43: 61. 1907.
3. *Carex coulteri* Boott, in Hemsley, Biol. Cent.-Amer., Bot. 3: 473. 1885.
4. *Carex guatemalensis* F. J. Hermann, Brittonia 23: 145. 1971.
5. *Carex longicaulis* Boeckeler, Flora 65: 62. 1882.
6. *Carex whitneyi* Olney, Proc. Amer. Acad. Arts 7: 394. 1868. ["Whitneyi."]

Mackenzie (1935: 272) recognized this section as "a group of dry-ground species of which five, confined to California and the mountains of Mexico, are known." *Carex* sect. *Longicaulis* refers to a small, apparently uniform group of species of uncertain relationships occurring in dry to mesic forests and forest openings. Mackenzie recognized *Carex flaccifolia* Mackenzie and *C. whitneyi* from California and *C. anisostachys*, *C. longicaulis*, and *C. coulteri* from Mexico. *Carex flaccifolia* was based on a presumably mislabeled specimen, and has long been placed into the synonymy of C. *whitneyi* (Howell, 1958). Howell (1958) also described *Carex jepsonii*, a segregate of *C. whitneyi*, now also not recognized (Mastrogiuseppe, 1993). Hermann (1974) recognized *Carex guatemalensis* in this section from Guatemala, and Reznicek (1993) resurrected the Mexican *C. ciliaris* at species rank, bringing the number of species in this section to six.

New Sections

Two new sections in subgenus *Carex* are here described for distinctive elements of the North American *Carex* flora.

Carex sect. **Glaucescentes** Reznicek, sect. nov. TYPE: *Carex glaucescens* Elliott, Sketch Bot. S. Carolina 2: 553. 1824.

Cespitosae. Culmi 50–150 cm alti, basi vaginis fuscis vel purpureo-fuscis. Folia 5–15, glauca, plus minusve papillata. Inflorescentia 10–40 cm longae, erectae vel arcuatae; spicis 3–8, ascendentibus vel arcuatis, pedunculatis, terminalibus staminatis, lateralibus staminatis, pistillatis, vel androgynis; bracteis infimis evaginatis vel brevivaginatis. Squamae pistillatae acutae vel retusae, aristatae. Perigynia papillata, anguste ovoidea vel late obovoidea, in rostrum contractum. Stigmata 3.

Caespitose in large, leafy clumps, rhizomes short and stout; basal sheaths coriaceous, brown to dull reddish purple. Culms central, 50–150 cm tall. Leaves 5 to 15, M-shaped in cross section, glaucous and ± papillose beneath; sheath fronts brownish hyaline, finely brown-dotted. Inflorescences 10–40 cm, with 3 to 8 spikes, terminal spikes staminate, lateral spikes pistillate or the distal 1 or 2 staminate or androgynous, peduncled, erect or pendent; proximal bracts leaf-like, exceeding the inflorescence, sheathless or short-sheathing. Pistillate scales acute to retuse, awned. Perigynia ascending or spreading, narrowly ovoid to broadly obovoid, rounded-trigonous to flattened-elliptic in cross section, strongly to weakly nerved, papillose, tapering or contracted to a short, entire or weakly bidentulate beak, stigmas 3, anthers 3, reddish.

Species Included:

1. *Carex brasiliensis* St.-Hilaire, Voy. Distr. Diam. 1: 369. 1833.
2. *Carex glaucescens* Elliott, Sketch Bot. S. Carolina 2: 553. 1824.
3. *Carex joorii* L. H. Bailey, Proc. Amer. Acad. Arts 22(1): 72. 1886.
4. *Carex verrucosa* Muhlenberg, Descr. Gram. 261. 1817.

Carex glaucescens, with its two close allies, *C. joorii* and *C. verrucosa*, form a tightly knit natural group of large, southeastern United States wetland species of acid soils in swamp forests, savannas, wet meadows, boggy depressions, and man-made habitats of similar character, such as ditches and shallow excavations. *Carex brasiliensis*, of wet savannas in temperate South America, appears to belong with these species, as first suggested by Boott (1860), although its affinities need more research.

Until now, these species have been awkwardly, and sometimes arbitrarily, placed in sections consisting of primarily Eurasian species of very dissimilar morphology. Kükenthal (1909) placed *Carex joorii* in his section *Maximae* (Ascherson) Kükenthal, but placed *C. glaucescens* (including *C. verrucosa*) and also *C. brasiliensis* in *Carex* sect. *Paludosae* G. Don. *Carex glaucescens* and its allies differ from all these species in their papillose perigynia and basal staminate flowers of the pistillate spikes, from species in section *Maximae* by their sheathless or short-sheathing bracts, and from almost all species in section *Paludosae* by their caespitose habit. Mackenzie (1935), on the other hand, kept *C. glaucescens*, *C. joorii*, and *C. verrucosa* together but placed them in his section *Pendulinae*, along with the Eurasian *C. flacca*. *Carex flacca* is a very different plant, however, being much smaller, with elongate, creeping rhizomes, scabrous-hispid perigynia, and awnless pistillate scales. *Carex glaucesens* and its allies, in fact, appear to have no close relatives in the *Carex* flora elsewhere in the world.

Carex sect. **Hirtifoliae** Reznicek, sect. nov. TYPE: *Carex hirtifolia* Mackenzie, Bull. Torrey Bot. Club 37: 244. 1910.

Laxe cespitosae vel coloniales, rhizomatibus brevirepentibus. Culmi 25–80 cm alti, arcuati, basi vaginis rubrobrunneis. Folia 3–5, molliter pubescentia, vaginis pubescentibus. Inflorescentiae 2–8 cm longae, erectae, spicis 2–5, ascendentibus, terminalibus staminatis, lateralibus pistillatis, brevipedunculatis; bracteis infimis evaginatis. Squamae pistillatae aristatae. Perigynia pubescentia, ellipsoidea-obovoidea, trigona, 2-nervata, in rostrum bidentatulum 0.7–1.5 mm longum contractum. Stigmata 3.

Loosely caespitose to colonial from short-creeping rhizomes; basal sheaths reddish brown pubescent. Culms lateral, 25–80 cm, flexuous, arching, pubescent. Leaves 3 to 5, M-shaped in cross section, soft pubescent, dark green, sheath fronts membranous. Inflorescences 2–8 cm, with 2 to 5 spikes, terminal spikes staminate, lateral spikes pistillate, short-peduncled, ascending; proximal bracts leaf-like, pubescent, sheathless or nearly so, usually shorter than inflorescence. Pistillate scales (at least the proximal ones) awned. Perigynia ascending, ellipsoid-obovoid, trigonous in cross section, nerveless on the faces, with 2 marginal nerves, pubescent, contracted to a bidentulate beak 0.7–1.5 mm long. Stigmas 3.

Species Included:

1. *Carex hirtifolia* Mackenzie, Bull. Torrey Bot. Club 37: 244. 1910. Replaced name: *Carex pubescens* Willdenow, Sp. Pl. 4(1): 281. 1805, not *C. pubescens* Poiret, Voy. Barbarie 2: 254. 1789.

Carex hirtifolia was placed by Mackenzie (1935: 215) in his inclusive section *Triquetrae*: "a group of dry ground species, represented in North America in the temperate and warmer parts by five species." Included were a diverse assemblage: *Carex hirtifolia*, a species of deciduous forests in the eastern United States and adjacent Canada; *C. triquetra* Boott, a species of the Mediterranean climate zone of California, extending into Baja California; *C. planostachys* Kunze, a calciphile of dry forests, scrub, and desert ranging from southwestern Arkansas, southern Oklahoma, and southeastern New Mexico south to Guatemala; and *C. dasycarpa* Muhlenberg and *C. tenax* Dewey, two species of dry, sandy, open forests of the coastal plain of the southeastern United States.

Carex hirtifolia differs strikingly from all the other species in Mackenzie's section *Triquetrae* in its relatively wide (4–9 mm), thin-textured, soft-pubescent foliage, long-beaked perigynia that are nerveless except for the two main ribs, red-tinged basal sheaths, primarily mesic deciduous forest ecology, and distribution in the northeastern and central United States and adjacent Canada.

The closest relatives of *Carex hirtifolia* are uncertain. The slender, long-beaked perigynia nerveless on the faces are similar to those of some species in section *Hymenochlaenae* (Drejer) L. H. Bailey, although *C. hirtifolia* lacks the elongate and usually pendent spikes typical of species in section *Hymenochlaenae*. *Carex hirtifolia* is known, however, to hybridize with some species in section *Hymenochlaenae*, including *C. gracillima* Schweinitz, forming *C.* ×*sullivantii* Boott (Cayouette & Catling, 1992), and also *C. arctata* Boott (Reznicek, unpublished data).

The remaining species in Mackenzie's section *Triquetrae* still comprise a diverse agglomeration. The Californian and Mexican *Carex triquetra* is quite different from all the remaining species in having relatively elongate, many-flowered spikes 1–

4.5 cm long, densely papillose, coriaceous leaves, and long-sheathing proximal bracts. It is probably best recognized as the only member of the monotypic section *Triquetrae*.

Carex planostachys and the recently described *C. lativena* S. D. Jones & G. D. Jones (Jones & Jones, 1993) from Texas, Arizona, and northern Mexico are extremely similar, and also very similar to the Mediterranean *C. halleriana* Asso and are best placed in section *Hallerianae* (Ascherson & Graebner) Rouy.

Carex tenax and *C. dasycarpa* can be tentatively included in section *Hallerianae* until further study. Like *C. planostachys*, *C. lativena*, and *C. halleriana*, they are dryland species with pubescent, many-nerved, trigonous, short-beaked perigynia in short spikes with sheathless or very short-sheathing bracts. However, they lack the characteristic basal spikes of *C. halleriana* and its allies, and further research may show they are not closely related to the other species in section *Hallerianae*.

Acknowledgments. I am grateful to Peter Ball for helpful discussions and for comments on the manuscript.

Literature Cited

Bailey, L. H. 1885. *Carex*. Pp. 370–397 *in* J. M. Coulter, Manual of the Botany of the Rocky Mountain Region. Ivison, Blakeman, Taylor, New York.

———. 1886. A preliminary synopsis of North American *Carex*. Proc. Amer. Acad. Arts 22: 59–157.

Boott, F. 1860. Illustrations of the Genus *Carex*. Part II. Pp. 75–105, pl. 201–310. William Pamplin, London.

Cayouette, J. & P. M. Catling. 1992. Hybridization in the genus *Carex* with special reference to North America. Bot. Rev. 58: 351–438.

Chater A. O. 1980. *Carex*. Pp. 290–323 *in* T. G. Tutin et al. (editors), Flora Europaea, Vol. 5. Cambridge Univ. Press, Cambridge.

Christ, H. 1885 [1886]. Nouveau Catalogue des *Carex* d'Europe. Bull. Soc. Roy. Bot. Belg. 24: 10–20.

Don, G. 1830. *Carex*. Pp. 376–377 *in* J. C. Loudon (editor), Hortus Brittanicus. Longman, Rees, Orme, Brown, & Green, London.

Egorova, T. V. 1999. The Sedges (*Carex* L.) of Russia and Adjacent States (within the limits of the former USSR). St.-Petersburg State Chemical-Pharmaceutical Academy, St. Petersburg, and Missouri Botanical Garden, St. Louis.

Kükenthal, G. 1909. Cyperaceae–Caricoideae. Pp. 1–824 *in* A. Engler (editor), Das Pflanzenreich. IV. Vol. 20, Heft 38. Wilhelm Engelmann, Leipzig.

Hermann, F. J. 1974. Manual of the Genus *Carex* in Mexico and Central America. Agric. Handb. 467, Forest Service, U.S.D.A. Washington.

Heuffel, J. 1858 [1859]. Enumeratio plantarum in Banatu temesiensis sponte crescentium at frequentius cultarum. Verh. Zool.-Bot. Ges. Wien 8: 39–240.

Howell, J. T. 1958. A reappraisal of *Carex flaccifolia*. Leafl. W. Bot. 8: 220–224.

———. 1961. The Tompkins-Tehipite expedition of the California Academy of Sciences. Leafl. W. Bot. 9: 181–187.

Jones, S. D.& G. D. Jones. 1993. A new species of *Carex* (Cyperaceae: *Triquetrae*) from the Chisos Mountains, Texas, and a key to the species of section *Triquetrae*. Sida 15: 509–518.

Mackenzie, K. K. 1931. Cariceae. N. Amer. Fl. 18: 1–10, 21–168.

———. 1935. Cariceae. N. Amer. Fl. 18: 11–20, 169–478.

Mastrogiuseppe, J. 1993. *Carex*. Pp. 1107–1138 *in* J. C. Hickman (editor), The Jepson Manual: Higher Plants of California. Univ. California Press, Berkeley.

Reznicek, A. A. 1993. *Carex*. Pp. 243–267 *in* R. McVaugh (editor) and W. R. Anderson (general editor), Flora Novo-Galiciana: A descriptive account of the vascular plants of western Mexico, Vol. 13. Univ. Michigan Press, Ann Arbor.

Stacey, J. W. 1939. Notes on *Carex*—XV. Leafl. W. Bot 2: 166–169.

Tucker, G. C. 1987. The genera of Cyperaceae in the southeastern United States. J. Arnold Arbor. 68: 361–445.

New Species and Combinations in *Larnax* (Solanaceae)

Neil W. Sawyer

Department of Biological Sciences, The University of Wisconsin-Whitewater,
800 West Main Street, Whitewater, Wisconsin 53109-1790, U.S.A.

ABSTRACT. Based on phylogenies generated using morphological and molecular data, *Deprea glabra* and *D. sylvarum* are transferred to *Larnax,* and a new subspecies, *L. sylvarum* subsp. *novogranatensis,* is described. Four new species are described and illustrated: *Larnax cuyacensis* from Peru, similar to *L. glabra* and *L. sylvarum,* but with a rotate, fleshier corolla much lighter in color, and a fruiting calyx tightly appressed to the berry; *L. grandiflora* from Peru, intermediate between *L. andersonii* and *L. sachapapa*; *L. parviflora* from Peru, similar to *L. psilophyta* of Ecuador, but differing in vegetative and reproductive characters and having the smallest flowers in the genus; and *L. darcyana* from Colombia, similar to *L. subtriflora* of Peru, but differing vegetatively and with much shorter, non-branching hairs, a smaller corolla, shorter filaments, and apiculate anthers. Keys are provided for selected genera and for *Larnax.* In addition, some synonymies are noted.

Key words: *Deprea, Larnax,* Solanaceae, South America.

The genus *Larnax* (Miers) Hunziker, native to montane regions of northwest South America, is among a group of approximately 12 so-called "physaloid" genera in the large tribe Solaneae (Averett, 1979; D'Arcy, 1991). Although closely aligned with *Deprea* Rafinesque, *Larnax* is certainly distinct in its floral and pollen morphology (Sawyer, 1999). The known diversity in *Larnax* has expanded in recent years to include 18 species (Hunziker, 1977; Hunziker & Barboza, 1995; Leiva, 1996; Leiva et al., 1998a, 1998b; Sawyer, 1998).

Species of *Larnax* are tropical Andean shrubs or small trees 0.3–5 m tall, occurring from northern Peru to Colombia. The taxonomic revisions herein extend their distribution as far north as Costa Rica. With few exceptions species are of limited distribution. Although infrequent in most habitats, they are recognized easily, like many shrubby taxa in this family, by their plagiotropic upper stem and leaf growth and by the axillary fascicles of from 1 to several flowers per node. Corolla color ranges from cream to yellow to purple, and can be variable within species (Sawyer & Benítez, 1998). Fruits are fleshy orange berries usually containing from 60 to over 100 small seeds. *Larnax* has been taxonomically associated with the genus *Deprea* Rafinesque (Barboza & Hunziker, 1994; Hunziker, 1977). Heteranthery is one character that delimits *Larnax* from *Deprea.* In *Deprea,* anthers in the same flower are of equal size, whereas in *Larnax,* the 5 anthers are grouped in arrays of either 2 or 3 different size classes. Other characters that separate these genera include the presence of thickened filament bases forming a stamen petalum (see Barboza & Hunziker, 1991) in *Larnax* (filament bases are never thickened in *Deprea*). the degree of corolla fusion (in *Deprea* corollas are infundibular, with the limb shorter than or equal to the tube; in *Larnax* corollas are always rotate-campanulate, the limb always longer than the tube), and the echinate pollen morphology in *Larnax* vs. rugulate in *Deprea* (Barboza & Hunziker, 1994; Sawyer, 1999). A list of *Larnax* species and their synonymies is presented in Appendix 1. Not included are nomina nuda I have encountered in the literature and among museum specimens. These include "*Athenaea costaricensis*" applied by Bitter to *L. sylvarum,* "*A. weberbaueri*" applied by Bitter to *L. subtriflora,* and "*L. nieva*" (see Leiva et al., 1998b). Character-based cladistic analysis of *Deprea* and *Larnax* will be presented elsewhere.

Based on analyses from both morphological and molecular data (Sawyer, 1999) to be expanded upon elsewhere, the following new combinations are necessary.

Larnax glabra (Standley) N. W. Sawyer, comb. nov. Basionym: *Athenaea glabra* Standley, Trop. Woods 42: 32. 1935. *Deprea glabra* (Standley) Hunziker, Kurtziana 10: 25. 1977. TYPE: Ecuador. [Bolívar] Western cordillera above Balsapampa, 2600 m, 14 Dec. 1934, *A. Rimbach 239* (holotype, F lost, F photo; isotypes, B destroyed, G, GH, NY, WIS photo, Y not seen).

Results of canonical variates analysis have demonstrated that *Larnax glabra* is distinct from its sister species *L. sylvarum* (Fig. 1). *Larnax glabra* is

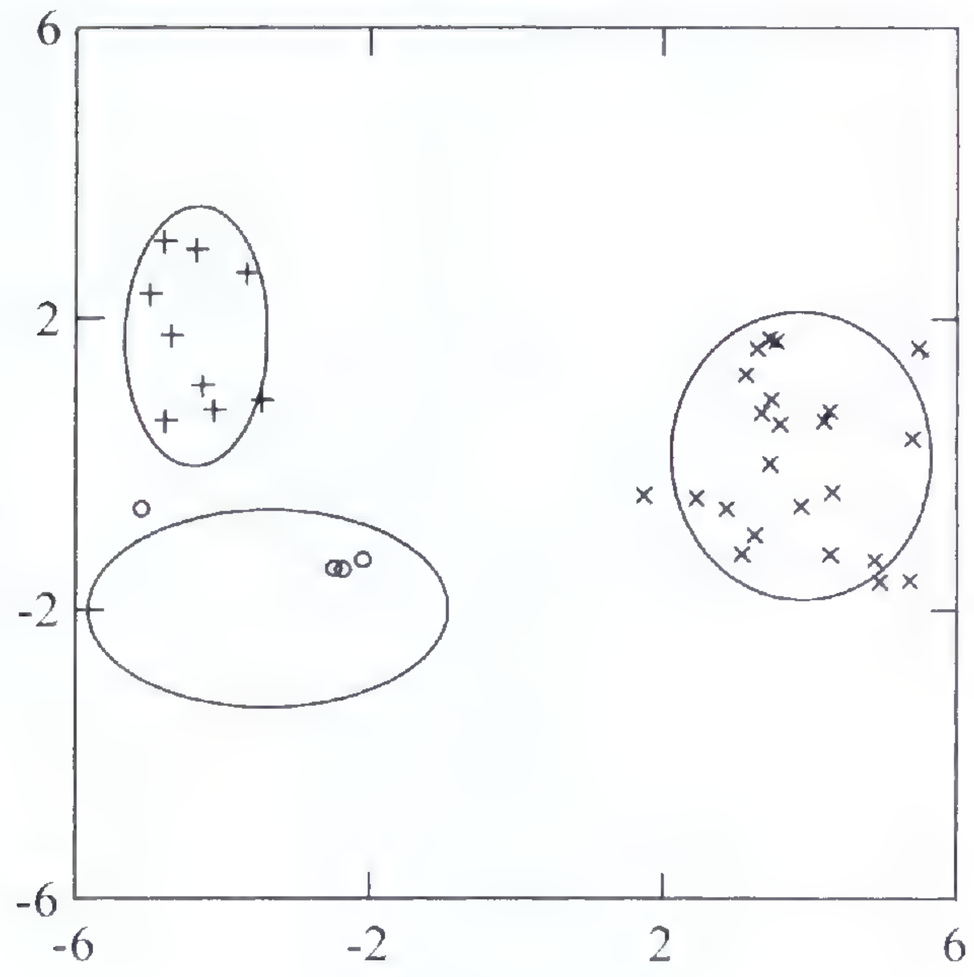


Figure 1. Canonical variates analysis using 10 continuous variables for Central American and Colombian populations of *Larnax sylvarum* and *L. glabra* from Colombia and Ecuador. Factor 1 accounts for 89.6% of the total variance; factor 2 accounts for the remaining 10.4%. Central American *L. sylvarum* = (0); *L. glabra* = (x); Colombian *L. sylvarum* = (+).

distinguished by its glabrous, somewhat fleshy and falcate leaves; the relatively large purple, campanulate corollas with lobes about equal to the corolla tube; and the presence of a stamen petalum with projections at the shoulders.

Habitat and distribution. *Larnax glabra* inhabits cloud forest and wet middle montane habitats from 1800 to 3700 m. This species has a relatively broad distribution in relation to many *Larnax* species, occurring from southern Ecuador to central Colombia.

Larnax sylvarum (Standley & C. V. Morton) N. W. Sawyer, comb. nov. Basionym: *Athenaea sylvarum* Standley & C. V. Morton, Field Mus. Nat. Hist. Bot. Ser. 18: 1036. 1938. *Deprea sylvarum* (Standley & C. V. Morton) Hunziker, Kurtziana 10: 25. 1977. TYPE: Costa Rica. San José: Finca La Cima, N of El Copey, 2100–2400 m, 21–22 Dec. 1925, *Standley 42812* (holotype, US; GH, WIS photos).

Characters that delimit *Larnax sylvarum* from *L. glabra* include its geminate leaves, the corolla usually with some green coloration present, the small size of the corolla and perianth, the occurrence of calcium oxalate crystals in the pollen sac, the occurrence of a stamen petalum without projections at the shoulders, the lustrous pale to whitish green fruiting calyx with purple veins, and the small berry.

Habitat and distribution. This species inhabits cloud forest and wet middle montane habitats from 1500 to 2900 m. This subspecies has been collected only in Central America in western Panama and Costa Rica. This is the only species in the group that occurs in Central America. It is entirely possible that this species has evolved by allopatric speciation of *L. glabra* following dispersal into Central America.

Larnax sylvarum (Standley & C. V. Morton) N. W. Sawyer subsp. **novogranatensis** N. W. Sawyer, subsp. nov. TYPE: Colombia. Antioquia: Mpio. Jardín, km 20 of road Jardín–Riosucio (Dpto. Caldas), ca. 15 km SSE of Jardín, Alto de Ventanas, 5°31′N, 75°48′W, 2700–2790 m, Oct. 1988, *J. Zarucchi, McPherson & Roldán 6926* (holotype, TEX; isotypes, COL, HUA).

A *L. sylvarum* subsp. *sylvarum* distinguitur foliis et staminum filamentis brevioribus; distantiis brevioribus inter folii nervos secondarios; pedicellis, corollis, calycis lobisque longioribus; corollae tubo, et calyce fructifero longiore; et fructu grandiore.

Morphometric analyses using the methods of Sawyer and Benítez de Rojas (1998) have shown individuals (10 from 3 populations) of *Larnax sylvarum* from northern Colombia group together, distinct from the Central American individuals (10 from 6 populations from northern Panama and Costa Rica) of *L. sylvarum* and *L. glabra* (10 from 10 populations from Colombia and Ecuador; Fig. 1). Of the 10 variables used (leaf apex width, leaf length, petiole length, hair length, corolla length, anther length, anther length/filament length, fruiting calyx length, fruiting calyx lobe length, and seed diameter), loadings for anther length, leaf apex width, and leaf length were highest for factor 1, and loadings for corolla length, anther length, and fruiting calyx length were highest for factor 2. Mahalanobis distances from a canonical variates analysis (SYSTAT 7, 1997, SPSS, Inc., Chicago) between group centroids showed all pairs to be significantly different ($P < 0.0001$). Wilks's lambda values (SYSTAT 7, 1997, SPSS, Inc., Chicago) also were highly significant ($P < 0.0001$). For these reasons, the subspecies *novogranatensis* is here described.

Habitat and distribution. This subspecies occurs only in north-central Colombia, disjunct and distinct from the distribution of subspecies *sylvarum*, which appears restricted to Central America. It occurs in wet montane and cloud forests from 2300 to nearly 3000 m. Its occurrence in northern

Colombia may be explained by recent dispersal events from Costa Rica to Colombia.

KEY TO SUBSPECIES OF *LARNAX SYLVARUM*

1a. Leaves to 7 cm long, secondary leaf veins to 7 mm apart; flowering pedicels to 10 mm long, corolla 7.5–10 mm long, corolla tube 3.3–5 mm long; filaments to 4.5 mm long; fruiting calyx 8–14 × 8–14 mm, fruiting calyx lobes 0.7–1.5 mm long, maximum fruit length 10 mm . . . . . *Larnax sylvarum* subsp. *novogranatensis*

1b. Leaves to 11 cm long, secondary leaf veins to 15 mm apart; flowering pedicels to 9 mm long, corolla 6.5–9.5 mm long, corolla tube 3–4.5 mm long; filaments to 6.2 mm long; fruiting calyx 7–8.5 × 6–7.8 mm, fruiting calyx lobes 0.3–1.4 mm long, maximum fruit length 7.5 mm . . . . . *Larnax sylvarum* subsp. *sylvarum*

Paratypes. COLOMBIA. **Antioquia:** Jardín, vía Jardín–Riosucio, bosque húmedo premontano, 7 km de Jardín, a orilla de riachuelo, 05°30′N, 75°50′W, 2020 m, June 1987 (fr), *Callejas et al. 3748* (COL); Vereda Ventanas, Jardín–Ventanas–Riosucio road, ca. 19.3 km SSE of Jardín, at border with Caldas, forest at highpoint of road (Ventanas), ca. 5°40′N, 75°47′W, 2830 m, May 1989 (bd, fl, fr), *Luteyn & Escobar 12750* (COL, HUA); carretera Jardín (Antioquia) Riosucio (Caldas), Sitio Ventanas, cerca a la torre repetidora de T.V., 2900 m, Apr. 1987 (bd, fl, fr), *Marulanda & Jaramillo 264* (HUA); carr. Jardín–Riosucio Sitio Ventanas, 2900 m, June 1987 (bd, fl, fr), *Marulanda et al. 481* (HUA). **Huila:** Comisaría del Caquetá, Cordillera Oriental sobre el filo divisorio, en Gabinete, 2300–2450 m, Mar. 1940 (bd, fl, fr), *Cuatrecasas 8458* (COL). **Nariño:** road to Laguna La Cocha, ca. 10 km E of Pasto, 1°12′N, 77°10′W, 3000 m, Jan. 1981 (fl, fr), *Gentry et al. 30404* (COL).

Larnax cuyacensis N. W. Sawyer & S. Leiva, sp. nov. TYPE: Peru. Piura: Ayabaca, Mpio. of Yacupampa, 8 km NE of Ayabaca above Las Cuyas, in quebrada, 4°37′S, 79°42′W, 2600 m, 6 June 1997, *N. W. Sawyer 797* (holotype, MO; isotypes, CONN, HAO, NY).

Species nova *L. glabrae* affinis, a qua corolla rotata carnosiora subviolacea, calyce fructifero adpresso arcte baccae, seminibus paucioribus differt.

Shrub or small tree, 0.8–5 m tall. Stems purple with branchlets strongly or weakly flexuous; nodes often swollen, glabrate; young stems sparsely puberulent. Leaves membranous, occasionally paired, elliptic, somewhat falcate, the apex acuminate, the base oblique, cuneate-attenuate, 4.5–10.5 × 1.5–4 cm, glabrous below and on the veins, sparsely puberulent above and along margins with multicellular, simple or occasionally branched, non-glandular hairs 0.3–0.8 mm long, leaves glabrate. Petiole 0.2–1.8 cm long, glabrous. Inflorescence axillary; flowers 3 to 6 per node in fascicles from a much reduced peduncle to 1.5 mm long and adnate to the stem. Flowers somewhat pendent or perpendicular to the stem on glabrate pedicels 3–12 mm long. Flowering calyx green with purple veins, glabrate, ca. 5 mm long, ca. 4 mm diam., with subulate lobes 1–1.2 mm long. Corolla campanulate-rotate, pale violet, somewhat fleshy, 2–3 mm wide at the base, 11–12.5 mm long, sparsely to moderately puberulent externally with non-glandular and branched hairs and sessile glands, the interior puberulent with 11–33 non-glandular hairs/mm², the tube 6–7 mm long, the lobes narrowly triangular, flared at anthesis, 5–6.5 mm long. Stamens exserted from the corolla tube, slightly exserted from the corolla limb. Filaments sparsely puberulent at their base with non-glandular hairs, the free portion 4.5–5.5 mm long, adnate to the basal quarter of the corolla tube and there broadened and thickened forming a stamen petalum, the bases separated by the corolla vasculature, the adnate portion 1–1.5 mm long. Anthers dorsifixed, white, ovate-elliptic, occurring in two or three size arrays, 2–2.3 × 1.2–1.5 mm, the bases of thecae connivent, calcium oxalate crystals occurring as druses in pollen sacs. Pollen echinate. Ovary glabrous, conical, ca. 1.5 mm long, ca. 1.5 mm diam., ringed basally by a nectary. Style glabrous, to ca. 9 mm long at anthesis, exserted prior to anthesis; stigma clavate. Fruiting pedicels glabrate, ca. 14 mm long. Fruiting calyx accrescent, tightly investing the fruit, open at the apex, greenish white with purple veins, globose, ca. 10 mm long, ca. 11 mm diam., sparsely puberulent externally, the interior with scattered sessile glands and 2-celled stalked glands with unicellular heads; lobes shallowly triangular-subulate, 0.6–1.2 mm long, of unequal lengths. Fruit a berry, immature berry cream, globose, 9–10 mm diam.; seeds ca. 12, 2.7–3.1 mm diam.

Larnax cuyacensis is similar to *L. glabra* and *L. sylvarum* but possesses a corolla that is rotate and fleshier, with much lighter coloration; calcium oxalate crystals in the pollen sac; a fruiting calyx that is tightly appressed to the berry; and fewer seeds.

Habitat and distribution. This species is only known from the region around Ayabaca, north of the Huancabamba deflection in northern Peru, from 2400 to 2600 m in montane forest. The distribution of this species and *L. glabra* and *L. sylvarum*, with which it is affiliated, forms a continuum extending from northern Peru to Costa Rica.

Paratypes. PERU. **Piura:** Montaña de Cuyas, 8 km NE of Ayabaca, 4°32′S, 79°44′W, 2400–2410 m, Sep. 1991 (fr), *Gentry et al. 75121* (MO); Ayabaca, Yacupampa, May 1971 (bd, fl, fr), *López et al. 7722* (NY); Ayabaca, Las Cuyas, 2580 m, 6 June 1997 (bd, fl, fr), *Sawyer 799* (CONN).

Larnax darcyana N. W. Sawyer, sp. nov. TYPE: Colombia. Huila: forest around Mehrenberg, road from Popayán, 2350 m, 6 July 1984, *W. G. D'Arcy, Gentry, Monsalve & Silverstone 15626* (holotype, MO; isotype, CONN). Figure 2.

A *L. subtriflora* ramulis non flexuosis, foliis glabratis parvioribus pilis haud ramosis multo brevioribus, corolla breviore, filamentis brevioribus, antheris apiculatis, calyce fructifero glabro costis adpressis differt.

Shrub to 2 m tall. Stems with branchlets seldom or weakly flexuous, glabrous; young stems sparsely to moderately puberulent. Leaves membranous, occasionally paired, elliptic, the apex acuminate, the base oblique, cuneate-attenuate, 3–9 × 1.4–5.2 cm, sparsely puberulent beneath, along veins and margin with multicellular, simple hairs 0.2–0.5 mm long; leaves glabrate. Petiole 0.4–1.5 cm long, sparsely to moderately puberulent, glabrate. Inflorescence axillary; flowers 1 to 4 per node in fascicles from a much reduced peduncle to 2.2 mm long either free or partially adnate to the stem. Flowers pendent on sparsely to moderately pubescent pedicels 3–7 mm long. Flowering calyx green, sparsely hirsute, ca. 2 mm long, ca. 3 mm diam., with lobes absent or with very shallow triangular or subulate lobes < 0.6 mm long. Corolla campanulate, pale greenish yellow, membranous, 7.8–10 mm long, ca. 2.5 mm wide at the base, sparsely hirsute and with sessile glands externally, the interior glabrous or with a few non-glandular hairs, the tube 2–3 mm long, the lobes triangular-acute, 5.5–7.2 mm long. Stamens exserted from the corolla tube, included in the corolla limb. Filaments glabrous, unequal in length, the free portion 1.8–3.1 mm long, adnate to the basal half of the corolla tube and there broadened and thickened forming a stamen petalum, the bases separated by the corolla vasculature, the adnate portion 1–1.5 mm long. Anthers dorsifixed, connivent, ovate-elliptic, apiculate, occurring in 3 size arrays, 1.8–2.5 × 1.2–1.5 mm, the bases of thecae sagittate; calcium oxalate crystals occurring as druses in pollen sacs. Pollen surface type unknown. Ovary glabrous, conical, 1–1.1 × 0.8–1 mm, ringed basally by a nectary. Style glabrous, 4.5–5.5 mm long; stigma clavate. Fruiting pedicels sparsely to moderately puberulent, 7–14 mm long. Fruiting calyx accrescent, the basal half tightly investing the fruit, open at the apex, lustrous green and purple with dark green or purple veins, somewhat pyriform-urceolate, 11–16.5 × 9.5–11 mm, glabrous within and without; lobes subulate, < 0.8 mm long, of unequal lengths. Fruit an orange berry, globose, 8–11 mm diam.; seeds 40–65; 2.9–3.8 mm diam.

This species is similar to *L. subtriflora* of Peru, but *L. darcyana* lacks the flexuous stems of *L. subtriflora*. *Larnax darcyana* has smaller, sparsely puberulent leaves with much shorter, non-branching hairs, a smaller corolla, shorter filaments, apiculate anthers, calcium oxalate crystals in the pollen sac, and glabrous fruiting calyces with appressed costae.

Habitat and distribution. Known only from the wet montane forests of the Mehrenberg region in Huila Province and to the north in the Parque Regional Ucumarí in Risaralda, Colombia, from 2200 to 2400 m where it occurs with *L. hawkesii*.

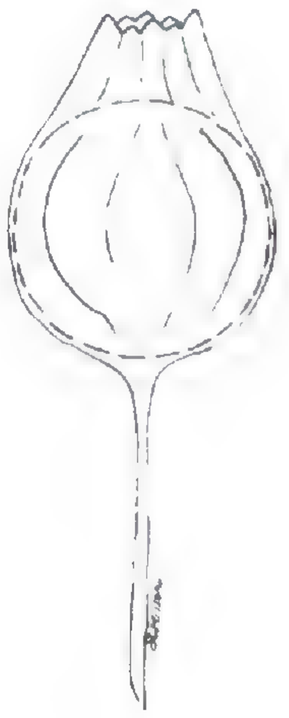
Paratypes. COLOMBIA. **Huila:** forest around Mehrenberg, road from Popayán, 2300 m, July 1984 (bd, fl), *D'Arcy et al. 15595, 15627* (MO); finca Mehrenberg E of Volcán Puracé, near Cauca border, 02°16′N, 76°12′W, 2300 m, Apr. 1986 (bd, fl, fr), *Gentry 53988* (NY, MO). **Risaralda:** Mpio. Pereira, Parque Regional Ucumarí, Cordillera Central, 4°45′N, 75°35′W, 1600 m, Aug. 1995 (bd, fr), *Murcia 390* (MO).

Larnax grandiflora N. W. Sawyer & S. Leiva, sp. nov. TYPE: Peru. Cajamarca: Mpio. San Ignacio, in forest along road from San Martín to El Chaupe, 5°11′S, 79°03′W, 1700 m, 26 June 1997, *N. W. Sawyer 827* (holotype, NY; isotypes, CONN, HAO, MO). Figure 3.

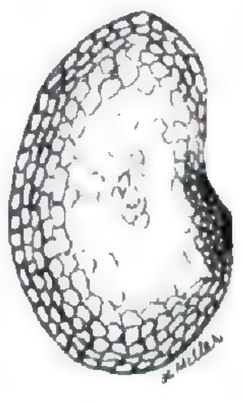
Planta inter *L. andersonii* et *L. sachapapa* quasi intermedia; a *L. andersonii* lobis calycis multo grandioribus, corolla multo grandiore differt; a *L. sachapapa* lobis calycis haud subulatis, intervenio corollae maculato atroviolaceo differt.

Shrub, 0.5–1.5 m tall. Stems with branchlets seldom or weakly flexuous, sericeous. Leaves membranous, always geminate, heterophyllous, the larger (major) leaves elliptic, the apex acuminate, the base oblique, cuneate-attenuate, 3–10.5 × 2–5 cm, the smaller (minor) leaves ovate or elliptic-ovate, the apex cuspidate, the base truncate, 1.5–2.5 × 1.2–2 cm, strigose to sericeous above, hirsute to sericeous below, especially along the veins with long, multicellular, simple hairs 0.6–1.8 mm long. Petiole 0.6–1.5 cm long on major leaves, 1–2 mm long on minor leaves, sericeous. Inflorescence axillary, distal on a branch; flowers solitary; peduncle lacking. Flowers pendent or perpendicular to the stem, on sericeous pedicels 5–15 mm long. Flowering calyx green, sericeous, to 9.4 mm long, ca. 4 mm diam., with lanceolate lobes 2–7 mm long, of unequal lengths. Corolla campanulate to rotate, pale greenish cream with lustrous violet maculations internally between the veins, membranous, 19–20 mm long, sericeous externally, the interior glabrate with 0 or 1 non-glandular hairs/mm^2, the

A. X ½



D. — 1 mm



E. —— 1 mm

B. — 1 mm

C.

Figure 2. *Larnax darcyana* N. W. Sawyer (*D'Arcy et al. 15626*). —A. Branch apex. —B. Interior of mature corolla and androecium. —C. Mature gynoecium. —D. Mature fruiting calyx. —E. Mature seed.

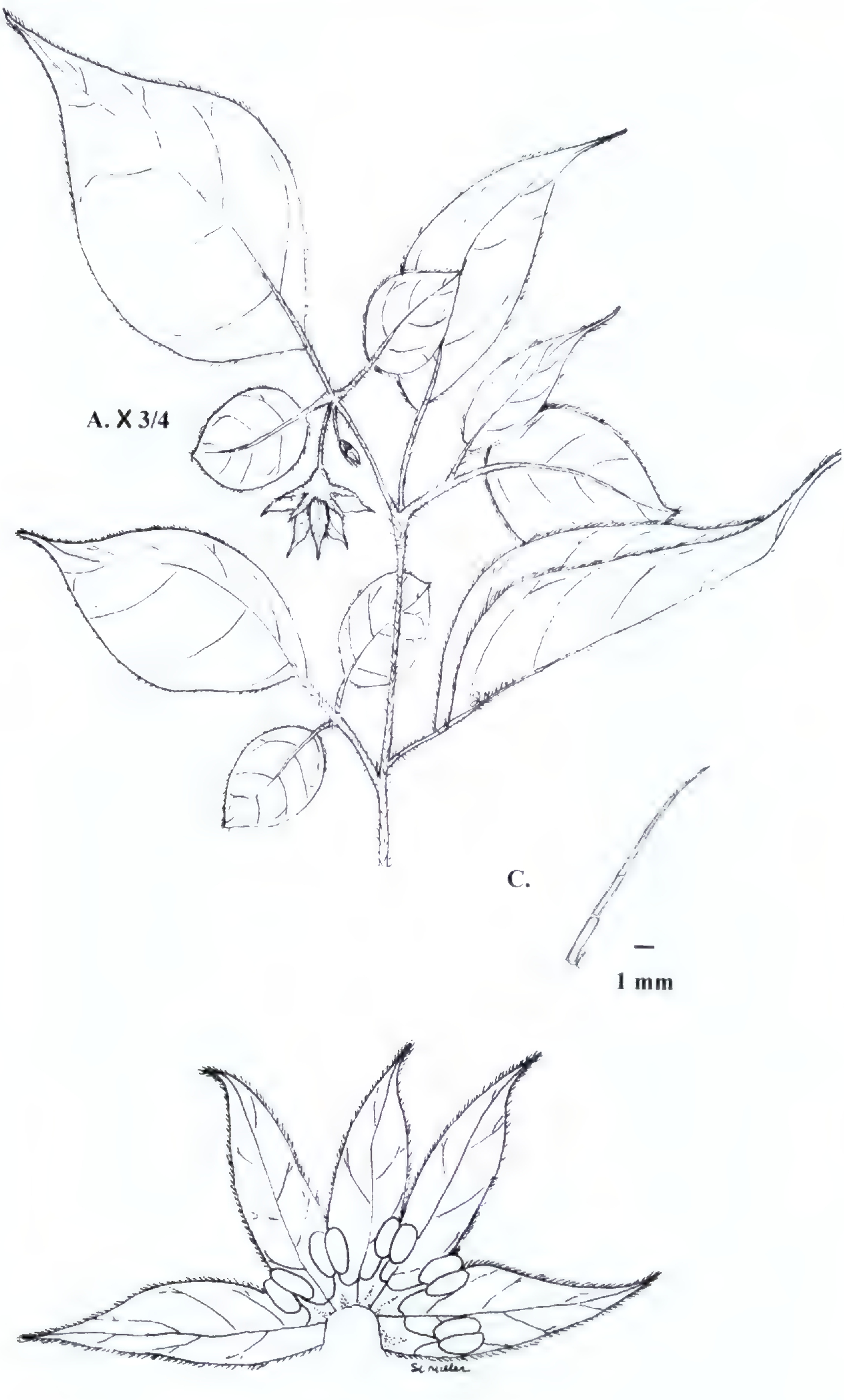


Figure 3. *Larnax grandiflora* N. W. Sawyer & S. Leiva (*Sawyer 827*). —A. Branch apex. —B. Interior of mature corolla and androecium. —C. Non-glandular leaf trichome.

tube 2–4 mm long, lobes narrowly triangular, reflexed at the apex, ca. 17 mm long, 4–4.5 mm wide at the base. Stamens exserted from the corolla tube, included within the corolla limb. Filaments glabrous, unequal in length, the free portion 2.5–3.5 mm long, adnate to the basal half of the corolla and there broadened and thickened forming a stamen petalum, the bases separated by the corolla vasculature, the adnate portion 1–1.6 mm long. Anthers dorsifixed, connivent, white to violet tinted, ovate to elliptic, occurring in 2 or 3 size classes, 1.8–2.3 × 1.5–1.9 mm, the bases of thecae sagittate; calcium oxalate crystals occurring as druses in pollen sacs. Pollen surface type unknown. Ovary glabrous, obovate to conical, 1.7–1.8 × 1.5–1.8 mm, ringed by a basal nectary. Style glabrous, ca. 5 mm long; stigma clavate. Fruit not known.

Similar to *L. andersonii*, this is the only other species in the genus displaying heterophyllous, geminate leaves and solitary flowers. Although the indumentum is abundant and composed of long hairs as in *L. andersonii*, bifurcating hairs are lacking. *Larnax sachapapa* and *L. grandiflora* have the largest flowers in the genus, both to 2 cm long. Unlike the well-collected *L. sachapapa*, the single known population of three individuals of *L. grandiflora* severely limits our knowledge of corolla size variation in this species. Unlike *L. sachapapa*, which has a yellowish green or white corolla, the corolla of *L. grandiflora* contains lustrous purple maculations between the primary and secondary veins internally, similar to that of *L. sagasteguii*. The flowering calyx of *L. grandiflora* possesses very long and narrow triangular lobes to 7 mm, a character unique to this species. The vegetative morphology of *L. grandiflora* appears intermediate between *L. andersonii* and *L. sachapapa*, both of which occur in northern Peru.

Habitat and distribution. This species has been collected only in Mpio. San Ignacio, Peru, in wet, relict montane forest at an elevation of ca. 1700 m.

Larnax parviflora N. W. Sawyer & S. Leiva, sp. nov. TYPE: Peru. Cajamarca: Mpio. Cutervo, Bosque Cutervo, Parque National de Cutervo, NW corner of Cordillera Tarros, Chorro Blanco sector, ca. 10 km WNW of San Andreas, 6°12′S, 78°46′W, 2650 m, 4 Nov. 1990, *M. Dillon, Sánchez & Guevara 6141* (holotype, F; isotype, HAO). Figure 4.

Ab aliis speciebus generis distinguitur caulibus et foliis glabris, 1–3 floribus axillaribus, corolla sulphurea et minus quam 5 mm longa petalis reflexis, limbo interius corollae pilis brevibus annularibus, fructu assurgenti, et seminibus paucis. Ab affinibus *L. psilophytae* aequatorialis praeclare differt amplitudine et colore corollae et habitu arboris.

Shrub or small tree from 0.3 to 5 m tall. Stems dull greenish brown with branchlets seldom or slightly flexuous, glabrous. Leaves somewhat fleshy, occasionally paired, elliptic, the apex acute, the base oblique, cuneate, 2.5–11.5 × 1–4.5 cm, glabrous. Petioles on mature, more terminal leaves 0.2–0.7 cm long to 2.8 cm long on lower (shaded) leaves, sparsely puberulent with short pluricellular, non-glandular hairs. Inflorescence axillary, flowers 1 to 3 per node from a peduncle ca. 0.6 mm long, this adnate to the stem. Flowers somewhat pendent or perpendicular to the stem on sparsely puberulent pedicels 3–6 mm long. Flowering calyx green, 1–1.8 × 2.5–3 mm, sparsely pubescent externally with 1- or 2-celled non-glandular hairs and sessile, unicellular glands, the lobes absent or shallowly triangular, < 0.2 mm long. Corolla campanulate to rotate, pallid yellow, somewhat fleshy, 3.5–4.8 mm long, with sessile glands, otherwise glabrous externally, the interior sparsely to moderately puberulent with 6–25 non-glandular hairs/mm², tube 1.3–1.6 mm long, the lobes triangular, rotate-reflexed, 2–2.5 mm long, ca. 1.5 mm wide at the base. Stamens completely exserted in anthesis. Filament base sparsely hirsute with short uni- or bi-cellular hairs, otherwise glabrous; filaments unequal in length, the free portion 1.3–1.9 mm long, adnate to ca. the basal half of the corolla and there broadened and thickened forming a stamen petalum, the bases separated by the corolla vasculature, the adnate portion 0.5–1 mm long. Anthers dorsifixed, connivent, white, ovate to elliptic, occurring in 2 or 3 size classes, the shortest anther commonly aborting when 3 size classes present, 0.8–1.6 × 0.7–1.3 mm, the bases of thecae sagittate; calcium oxalate crystals occurring as druses and blocks in pollen sacs. Pollen echinate. Ovary glabrous, ovate to conical, 1–1.2 × 1 mm, ringed at the base by a nectary. Style often involute, 3.5–4.2 mm long, exserted prior to anthesis; stigma clavate. Fruiting pedicels assurgent, 11–20 mm long, sparsely pubescent. Fruiting calyx accrescent, tightly investing the fruit, open at the apex, green with inconspicuous ribs, urceolate with apex narrowing and slightly lengthened above the berry, 5–6 × 5–5.2 mm, exterior and interior glabrous, sessile glands present externally; lobes lacking or with minute teeth of unequal lengths no longer than 0.5 mm. Berry turning from green to orange to purple, glo-

Figure 4. *Larnax parviflora* N. W. Sawyer & S. Leiva (*Dillon et al. 6141*). —A. Branch apex. —B. Mature flower. —C. Interior of mature corolla and androecium. —D. Mature gynoecium. —E. Mature fruiting calyx.

bose, ca. 5 mm diam., seeds 15 to 20, 1.6–2.6 mm long.

This species is very similar to the Ecuadorian endemic *L. psilophyta*, its counterpart north of the Huancabamba deflection of northern Peru. Several shared attributes separate these from other *Larnax* species, which include the small, glabrous, fleshy leaves; more or less pendent inflorescences that become assurgent in fruit; small corollas with rotate limbs that lack anthocyanins; corollas that are essentially glabrous externally with an annular ring of hairs on the interior surface; and relatively few seeds.

Habitat and distribution. *Larnax parviflora*, collected from only two sites, appears to be endemic and limited in its distribution to the region around Cutervo, Cajamarca, in northern Peru. It has been found in relict montane and cloud forests and in somewhat disturbed primary forests from 2350 to 2650 m.

KEY TO *LARNAX PARVIFLORA* AND *L. PSILOPHYTA*

1a. Shrub or tree to 5 m tall; leaves pliant; corolla 3.5–4.8 mm long and yellow; anthers 0.8–1.6 mm long; fruiting pedicels 11–20 mm long . . . . . *Larnax parviflora*

1b. Shrub to 2 m tall; leaves indurate; corolla 4–7 mm long and green; anthers 1.2–1.9 mm long; fruiting pedicels 6–9 mm long *Larnax psilophyta*

Paratypes. PERU. **Cajamarca:** Mpio. Cutervo, San Andreas, in La Pucarilla, 2350 m, 12 Aug. 1996 (bd, fl), *Sawyer 776* (CONN); Cutervo, above El Verde on road to Sto. Domingo de La Capilla, 6°19′S, 78°50′W, 2540 m, 15 June 1997 (bd, fl, fr), *Sawyer 819* (CONN); Mpio. Cutervo, San Andreas, en la Pucarilla, 2500 m, June 1988 (bd, fl, fr), *Vega 451* (F).

Larnax longipedunculata S. Leiva, Rodríguez & Campos, Arnaldoa 5: 194. 1998. TYPE: Peru. Cajamarca: Prov. San Ignacio, Caserío La Bermeja, bosques de neblina La Bermeja, Dist. Tabaconas, 1830 m, 4 Jan. 1998, *S. Leiva et al. 2098* (holotype, HAO not seen; isotypes, CONN, CORD not seen, F not seen, HAO not seen, HUT not seen, M not seen, MO not seen).

Larnax macrocalyx S. Leiva, Rodríguez & Campos, Arnaldoa 5: 197. 1998. Syn. nov. TYPE: Peru. Cajamarca: Prov. San Ignacio, Dist. Tabaconas, Caserío La Bermeja, bosques de neblina La Bermeja, La Bermeja-Huaquillo, 1700–1940 m, 20 Nov. 1997, *Rodríguez & Cruz 2052* (holotype, HUT not seen; isotypes, AMAZ not seen, CONN, CORD not seen, F not seen, HAO not seen, HUT not seen, M not seen, MO not seen, MOL not seen, NY not seen, USM not seen).

Thorough study by Sawyer of the isotype of *S. Leiva et al. 2098* (*L. longipedunculata*) and *Rodríguez & Cruz 2052* (*L. macrocaylx*) at CONN has provided evidence for synonymizing *L. macrocalyx* with *L. longipedunculata.* All the collections, only five in total, of *L. longipedunculata* and *L. macrocaylx* are from the same locality. The major differences listed by Leiva et al. (1998b) between these species are in the size of the leaves, the fruiting calyx, and the length of the accompanying fruiting pedicel. These discrepancies may be due solely to differences in age or local ecology. Considering the amount of variation that has been demonstrated in the genus (Sawyer, 1999), these minor differences do not, in my opinion, form enough of a basis for delineation, and *L. macrocalyx* is here treated as a synonym of *L. longipedunculata.*

Larnax sachapapa Hunziker, Kurtziana 10: 13. 1977. TYPE: Ecuador. Azuay: forested slopes between Cruz Pamba and Loma de Canela, in region of Río Sadracay (tributary of Río Mehuír), N of Molleturo, 2300–2500 m, 12 July 1943, *Steyermark 52965* (holotype, VEN).

Larnax pilosa S. Leiva, Rodríguez & Campos, Arnaldoa 5: 200. 1998. Syn. nov. TYPE: Peru. Cajamarca. Prov. San Ignacio, Dist. San José de Lourdes: Estrella del Oriente, 1600 m, 4°50′S, 78°55′W, 8 Jan. 1998, *S. Leiva, Campos & Rodríguez 2108* (holotype, HAO not seen; isotypes, CONN, CORD not seen, F not seen, HAO not seen, HUT not seen, M not seen, MO not seen, USM not seen).

Thorough study by Sawyer of an isotype of *S. Leiva et al. 2108* (CONN) described by Leiva et al. (1998b) as the new species *L. pilosa* has provided evidence for synonymizing *L. pilosa* with *L. sachapapa. S. Leiva et al. 2108* is undoubtedly a specimen of *L. sachapapa* as evidenced by its vegetative, floral, and fruiting characteristics, particularly the distinctive strongly subulate calyx lobes > 0.7 mm long. This collection extends the distribution of this species into Peru, making it the most widely distributed of any *Larnax* species (Colombia to Peru).

Evidence from morphology and ITS nrDNA sequence data indicates that *Deprea* and *Larnax* are distinct (Sawyer, 1999). Phylogenies generated from these data provide the basis for the transfer here of *D. glabra* and *D. sylvarum* to *Larnax.* Morphometric analyses have revealed notable differences between the Colombian and Central American representatives of *L. sylvarum* (Fig. 1), providing evidence for the circumscription of a Colombian subspecies, designated here *L. sylva-*

rum subsp. *novogranatensis*. In this article, four new species of *Larnax* are described and synonymies are noted. Hence, to date, 22 *Larnax* species are known from northwestern South America.

Within the last several years, many new species of *Larnax* have been described. When annotating museum specimens, it rapidly becomes evident that an enormous amount of confusion exists among taxonomists as to the identity of *Larnax* species. In order to provide researchers with relevant taxonomic information and to aid researchers and herbaria in identifying museum material, the following keys are provided for selected genera within tribe Solaneae that share valvate corolla aestivation with *Larnax* (and *Deprea*) and for species of *Larnax*.

Synoptic Key to Selected Genera of Tribe Solaneae with Valvate Corolla Aestivation

1a. Calyx not accrescent.
  2a. Corolla lobes shorter than tube; filaments longer than anthers; fruiting calyx margin torn by expanding berry; Mexico to Brazil . . . . . *Acnistus* Schott
  2b. Corolla lobes longer than tube; filaments shorter than anthers; fruiting calyx margin intact; Bolivia, Brazil, Uruguay . . . . . *Aureliana* Sendtner
1b. Calyx accrescent.
  3a. Seeds fabiform and spherical; more than 9 flowers per inflorescence; Central America . . . *Brachistus* Miers
  3b. Seeds reniform and compressed; 1–7 flowers per inflorescence.
    4a. Corolla infundibular; filament gradually expanding basipetally where adnate to corolla; anthers equal in size.
      5a. Filaments adnate to corolla for ≥ 2.5 mm, calyx lobes unequal, distribution exclusively New World; Venezuela to Peru and Bolivia . . . . . *Deprea* Raffinesque
      5b. Filaments adnate to corolla for < 1.8 mm, calyx lobes equal, distribution exclusively Old World; Europe and northern Africa to Nepal . . . . . *Withania* Pauquy
    4b. Corolla campanulate-rotate; filament base abruptly expanded where adnate to corolla; anthers heterodynamous; Costa Rica to Peru . . . . . *Larnax* (Miers) Hunziker

Synoptic Key to the Species of *Larnax* (*L. grandiflora* Excluded)

1a. Fruiting calyx tightly investing berry.
  2a. Fruiting calyx appressed to berry, urceolate.
    3a. Corolla ≥ 9 mm long, the lobes flared.
      4a. Mature fruiting calyx incompletely investing berry, the lobes ≥ 1.3 mm long.
        5a. Corolla yellow and lacking anthocyanins, the annulus of only non-glandular hairs; mature fruiting calyx intact; anthers ≤ 2.2 mm long; seeds < 50 per fruit; Peru . . . . . *L. lutea* S. Leiva
        5b. Corolla greenish white with anthocyanins, the annulus of non-glandular and glandular hairs; mature fruiting calyx splitting; anthers ≥ 2.2 mm long; seeds > 50 per fruit; Peru . . . . . *L. sagasteguii* S. Leiva, V. Quipuscoa & N. W. Sawyer
      4b. Mature fruiting calyx completely investing berry, the lobes ≤ 1.2 mm long.
        6a. Corolla unicolored, pale violet; Peru . . *L. cuyacensis* N. W. Sawyer & S. Leiva, sp. nov.
        6b. Corolla bicolored, yellow with purple or brown maculations.
          7a. Mature leaves to 6 cm wide; 1–4 flowers per node; filaments 3.5–6 mm long; corolla with branched hairs; fruiting calyx > 50 mm^2; fruit orange; Ecuador and Peru . . . . . *L. suffruticosa* (Dammer) Hunziker
          7b. Mature leaves < 1.5 cm wide; 1–2 flowers per node; filaments 2.5–3 mm long; corolla lacking branched hairs; fruiting calyx < 50 mm^2; fruit purple; Ecuador . . . . . *L. steyermarkii* Hunziker
    3b. Corollas ≤ 9 mm long, the limb rotate.
      8a. Corolla > 7 mm long with anthocyanins present; berry at least 10 mm diam.; Peru . . . . . *L. sawyeriana* S. Leiva, Rodríguez & Campos
      8b. Corolla < 7 mm long with anthocyanins lacking; berry < 8 mm diam.
        9a. Corolla green, 4–7 mm long; fruiting pedicel 6–9 mm long; leaves fleshy-indurate; anthers 1.2—1.9 mm long, shrub; Ecuador . . . . . *L. psilophyta* N. W. Sawyer
        9b. Corolla yellow, < 5 mm long; fruiting pedicel 11–20 mm long; leaves somewhat fleshy; anthers < 1.6 mm long, shrub or tree; Peru . . . . . *L. parviflora* N. W. Sawyer & S. Leiva, sp. nov.
  2b. Fruiting calyx other than entirely appressed to berry, at least a portion of calyx apex free from berry, pyriform, or elongate-elliptic.
    10a. Fruiting calyx pyriform; berry globose or pyriform.
      11a. Corolla ≥ 8 mm long and yellow or white, the limb flared or without flexion; nodes green.

12a. Corolla yellow or yellow with purple or brown; berry globose; fruiting calyx lobes absent or dentate, < 0.5 mm long.
13a. Corolla glabrous within, yellow.
14a. Corolla > 10 mm long; plant pubescent with hairs > 1.2 mm long, branched hairs present; fruiting calyx pubescent, apex free of fruit; Peru . . . . . *L. subtriflora* (Ruiz & Pavón) Miers
14b. Corolla < 10 mm long; plant sparsely puberulent with hairs < 0.9 mm long, branched hairs absent; fruiting calyx glabrescent, upper ½ free of fruit; Colombia . . . . . *L. darcyana* N. W. Sawyer, sp. nov.
13b. Corolla pubescent within, yellow with purple or brown; Ecuador and Peru . . . . . *L. suffruticosa* (Dammer) Hunziker
12b. Corolla greenish white; berry pyriform; fruiting calyx lobes strongly subulate, > 0.7 mm long; Colombia, Ecuador, and Peru . . . . . *L. sachapapa* Hunziker
11b. Corolla ≤ 6 mm long and green, limb rotate; nodes with purple striations . . . . . *L. vasquezii* S. Leiva, Rodríguez & Campos
10b. Fruiting calyx elongate-fusiform; berry elongate-elliptic.
15a. Petiole > 2 cm long; fruiting calyx lobes to 4 mm long; corolla < 8 mm long, green with anthocyanins; anthers < 2 mm long; Colombia and Ecuador . . . . . *L. hawkesii* Hunziker
15b. Petiole < 1 cm long; fruiting calyx lobes < 0.5 mm long; corolla > 10 mm long, green without anthocyanins; anthers > 2 mm long; Ecuador . . *L. harlingiana* Hunziker & Barboza

1b. Fruiting calyx loosely enveloping berry.
16a. Fruiting calyx urceolate; calyx ribs appressed or elevated.
17a. Flowers solitary, calyx ribs appressed, corolla interior glabrous or nearly so; Ecuador and Peru . . . . . *L. andersonii* N. W. Sawyer
17b. Flowers > 3 per inflorescence; calyx ribs elevated; corolla interior densely pubescent.
18a. Leaves glabrescent on veins and margins; anthers < 1.6 mm long; filaments < 5 mm long; corolla < 9 mm long; fruiting pedicels ≤ 8 mm long; berry < 6 mm diam.; Colombia, Panama, and Costa Rica . . . *L. sylvarum* (Standley & C. V. Morton) N. W. Sawyer, comb. nov.
18b. Leaves glabrous on veins and margins; anthers > 1.7 mm long; filament > 7 mm long; corolla > 9 mm long; fruiting pedicels 10–14 mm long; berry > 6 mm diam.; Colombia and Ecuador . . . . . *L. glabra* (Standley) N. W. Sawyer, comb. nov.
16b. Fruiting calyx pyriform–pyriform-invaginate; calyx ribs plicate.
19a. Corolla lobes uni-colored.
20a. Corolla white, the tube sometimes purple-spotted within; leaves membranous, geminate, to 24 cm long; berry 9–10 mm diam.; fruiting calyx lobes usually absent or triangular and somewhat subulate; seeds < 55; Ecuador and Peru . . . *L. peruviana* (Zahlbruckner) Hunziker
20b. Corolla purple; leaves lustrous, fleshy, attached singly, to 18 cm long; berry to 14.5 mm diam.; fruiting calyx lobes prominent, triangular; seeds > 55; Ecuador and Peru . . . . . *L. purpurea* S. Leiva
19b. Corolla lobes bicolored.
21a. Peduncle adnate to stem; leaves to 13 cm long; corolla green with interior solid violet-purple, ≥ 5 mm long, the limb longer than the tube; berry 7–9 mm diam.; Ecuador and Peru . . . . . *L. dilloniana* S. Leiva, V. Quipuscoa & N. W. Sawyer
21b. Peduncle free from stem, ≥ 5 mm long; leaves to 35 cm long; corolla green with interior violet maculations, ≤ 5 mm long, the limb equaling the tube; berry 8–12 mm diam.; Peru . . . . . *L. longipedunculata* S. Leiva, Rodríguez & Campos

Acknowledgments. This work would not have been possible without financial assistance provided by the Bamford Fund and Biology Summer Fellowship awards from the Department of Ecology and Evolutionary Biology, University of Connecticut, a Garden Club of America Award in Tropical Botany, a doctoral dissertation fellowship from the Research Foundation, University of Connecticut, the American Society of Plant Taxonomists, and the Organization for Tropical Studies. I thank the curators and staff at F, MO, NY, and K for their loans of herbarium specimens; Segundo Leiva for his tireless assistance and navigational skills; Gregory Anderson, William D'Arcy, Kent Holsinger, Armando Hunziker, Donald Les, Michael Nee, and Abundio Sagástegui for their invaluable guidance; and, finally, Shawna Miller for her wonderful illustrations.

Literature Cited

Averett, J. E. 1979. Biosystematics of the physaloid genera of the Solaneae in North America. Pp. 493–503 *in* J. G. Hawkes, R. N. Lester & A. D. Skelding (editors), The Biology and Taxonomy of the Solanaceae. Academic Press, London.

Barboza, G. E. & A. T. Hunziker. 1991. Estudios sobre Solanaceae XXXI. Peculiaridades del androceo de interés taxonómico en *Solanum*. Kurtziana 21: 185–194.

——— & ———. 1994. Estudios sobre Solanaceae XXXVII. Sinopsis taxonómica de *Deprea*. Kurtziana 23: 101–124.

Benítez de Rojas, C. E. & M. Martínez. 1995. *Larnax hunzikeriana* (Solanaceae: Solanoideae). Una nueva es-

pecie y la primera mención del género para Venezuela. Phytologia 78: 353–356.

D'Arcy, W. G. 1991. The Solanaceae since 1976, with a review of its biogeography. Pp. 75–137 *in* J. G. Hawkes, R. N. Lester, M. Nee & N. Estrada (editors), Solanaceae III: Taxonomy, Chemistry, Evolution. Royal Botanic Gardens, Kew, and Linnean Society of London.

Hunziker, A. T. 1977. Estudios sobre Solanaceae VIII. Novedades varias sobre tribus, géneros, secciones y especies de Sud América. Kurtziana 10: 7–50.

——— & G. E. Barboza. 1995. Estudios sobre Solanaceae. XL. Una nueva especie ecuatoriana de *Larnax*. Kurtziana 24: 157–160.

Leiva, S. 1996. Dos nuevas especies de *Larnax* (Solanaceae: Solaneae) del Norte del Perú. Arnaldoa 4: 15–22.

———, V. Quipuscoa & N. Sawyer. 1998a. Dos nuevas especies de *Larnax* (Solanaceae) de Ecuador y Perú. Arnaldoa 5: 83–92.

———, E. Rodríguez & J. Campos. 1998b. Cinco nuevas especies de *Larnax* (Solanaceae: Solaneae) de los bosques montanos del Norte de Perú. Arnaldoa 5: 193–210.

Sawyer, N. W. 1998. Two new species of *Larnax* (Solanaceae) from Ecuador. Novon 8: 72–76.

———. 1999. The Systematics of *Deprea* and *Larnax* (Solanaceae). Ph.D. Dissertation, University of Connecticut, Storrs, Connecticut.

——— & C. E. Benítez de Rojas. 1998. Morphological analysis of three equivocal sibling species of *Deprea* (Solanaceae). Brittonia 50: 364–375.

Appendix 1. Revised nomenclature for species of *Larnax*. Accepted names are in boldface.

1. L. andersonii N. W. Sawyer
2. L. cuyacensis N. W. Sawyer & S. Leiva
3. L. darcyana N. W. Sawyer
4. L. dilloniana S. Leiva, V. Quipuscoa & N. W. Sawyer
5. L. glabra (Standley) N. W. Sawyer
Athenaea glabra Standley
Deprea glabra (Standley) Hunziker
6. L. grandiflora N. W. Sawyer & S. Leiva
7. L. harlingiana Hunziker & Barboza
8. L. hawkesii Hunziker
9. L. longipedunculata S. Leiva, Rodríguez & Campos
L. macrocalyx S. Leiva, Rodríguez & Campos
10. L. lutea S Leiva
11. L. parviflora N. W. Sawyer & S. Leiva
12. L. peruviana (Zahlbruckner) Hunziker
Athenaea peruviana Zahlbruckner
Withania peruviana (Zahlbruckner) Macbride
13. L. psilophyta N. W. Sawyer
14. L. purpurea S. Leiva
15. L. sachapapa Hunziker
L. pilosa S. Leiva, Rodríguez & Campos
16. L. sagasteguii S. Leiva, V. Quipuscoa & N. W. Sawyer
17. L. sawyeriana S. Leiva, Rodríguez & Campos
18. L. steyermarkii Hunziker
19. L. subtriflora (Ruiz & Pavón)
Physalis subtriflora Ruiz & Pavón
Withania subtriflora (Ruiz & Pavón) Dunal
20. L. suffruticosa (Dammer) Hunziker
Iochroma suffruticosa Dammer
21. L. sylvarum (Standley & C. V. Morton) N. W. Sawyer
Athenaea sylvarum Standley & C. V. Morton
Deprea sylvarum (Standley & C. V. Morton) Hunziker
22. L. vasquezii S. Leiva, Rodríguez & Campos

Lippia magentea, a New Species of Verbenaceae from Brazil

Tânia Regina dos Santos Silva

Departamento de Ciências Biológicas, Universidade Estadual de Feira de Santana, BR 116, km 3, CEP 44031–460, Feira de Santana, Bahia, Brazil

ABSTRACT. During a revision of *Lantana* (Verbenaceae), an undescribed species was discovered from Brazil. *Lippia magentea*, which is named for its corolla color, is a hirsute shrub from Bahia and Minas Gerais. Inflorescences in *Lippia magentea* do not exceed the leaves, and its fruits have two pyrenes.

Key words: Brazil, *Lantana*, *Lippia*, Verbenaceae.

The genus *Lippia* L. belongs to the tribe Lantaninae (Junell, 1934) in Verbenaceae. It has a bicarpellate ovary with two locules and a schizocarp splitting into two nutlets (two pyrenes).

1. Lippia magentea T. Silva, sp. nov. TYPE: Brazil. Bahia: Abaíra, Catolés, 13°17′30″S, 41°51′13″W, 23 Mar. 1999, *R. M. Harley, A. M. Giulietti, A. Zanin, R. P. Oliveira & M. N. Silva 53635* (holotype, HUEFS; isotype, SPF). Figure 1.

Haec species a congeneris habitu fruticoso, indumento hirsuto; foliis amplis; inflorescentia foliis breviore bracteis inter se aequalibus munita; corolla magentea atque fructus pyrenis duabus distinguitur.

Shrub ca. 0.5–4 m tall; branches erect, unarmed; plants hirsute throughout, trichomes simple, white. Leaves decussate, membranous; petioles 1–1.5 cm long; blade 6–12 × 3–5.5 cm, ovate, apex acute, base cuneate, margins serrate. Inflorescence solitary, axillary, 4.5–5.5 cm long, shorter than leaves, rachis ca. 1.5 cm long, not elongating in fruit; bracts similar, imbricate, magenta, 10–15 × 3–5.5 mm, ovate, apex acuminate, persistent in fruit. Calyx ca. 2 mm long, 2 lipped, lobes rounded; corolla magenta, tube ca. 9 mm long, velutinous, throat golden yellow, fleshy. Immature fruit green, black when mature, surface smooth, mesocarp thin; pyrenes 2.

Lippia magentea is found in the states of Minas Gerais and Bahia, Brazil, in caatinga and cerrado. Caatinga is characterized by much branched, spiny trees, with a pronounced and long dry season, rainfall of less than 800 mm/year, unevenly distributed (Mori, 1989). Cerrado is characterized by trees with contorted growth forms, thick barks, deep root systems or underground stems, with a distinct dry season, between 700 and 1750 mm/year rainfall, with rainfall occurring predictably every year (Mori, 1989). Flowering and fruiting take place between February and April and also in July, August, November, and December. This species is characterized by its shrubby habit, hirsute indumentum, large leaves to 13.5 cm long, inflorescence shorter than leaves, the bracts similar, corollas magenta, and fruits of two pyrenes. *Lippia magentea* resembles *L. macrophylla* Chamisso in its similar habit, and in having inflorescences shorter than leaves. However, *L. macrophylla* has velutinous indument, inflorescences larger than leaves, and calyx lobes with acute apices. *Lippia magentea* is found in caatinga and cerrado, whereas *L. macrophylla* is found only in Atlantic coastal forests.

Paratypes. BRAZIL. **Bahia:** Abaíra, serra do Atalho, 18 Apr. 1994, *E. Melo et al. 979* (HUEFS), 14 Feb. 1992, *L. P. Queiroz 2620* (HUEFS); estrada Catolés–Barra, 3–5 km de Catolés, 27 Feb. 1992, *B. Stannard et al. H 51631* (K, SPF); Boninal, 24 Nov. 1985, *G. Hatschbach & J. M. Silva 50147* (MBM); Caetité, 20 Mar. 1980, *S. Mori & F. Benton 13483* (NY, RB); Campo Bonito, s.d., *Geraldo Pinto s.n.* (RB 199352); Ibiquera, June 1973, *G. Pinto s.n.* (ALCB 3596, RB); Morro do Chapéu, Ventura, 27 Aug. 1981, *J. D. C. A. Ferreira 37* (HRB, K, NY); Mucugê, 13 km de Mucugê, 16 Dec. 1984, *G. P. Lewis et al. CFCR 7001* (K, SPF); Piatã, Serra do Atalho, 26 Dec. 1992, *R. M. Harley et al. H 50433* (K, SPF); Rio de Contas, 18 June 2000, *R. M. Harley 53989* (HUEF, MO); Sincorá, 16 Feb. 1943, *R. L. Froés 20219* (NY); Serra do Curral, 8 Mar. 1974, *R. M. Harley et al. 17000* (CEPEC, K), 1840, *Blanchet 3140* (G, OXF). **Minas Gerais:** Francisco de Sá, rod. p/ Grão-Mogol, 20 Apr. 1978, *G. Hatschbach 41218* (MBM, NY); Montezuma, ca. de 23 km em direção a Montugaba (BA), 14 Mar. 1994, *V. C. Souza et al. 5499* (K, SPF); 16 km N W de Lagoinha, 8 Mar. 1974, *R. M. Harley et al. 1700* (IPA, RB).

Acknowledgments. I thank Raymond Harley for assistance with the English translation, and José Jerônimo de Moraes and Roy Gereau for assistance with the Latin diagnosis. Thanks also to the directors and curators of ALCB, CEPEC, EAC, ESA, G, HRB, HUEFS, IBGE, IPA, K, MBM, NY, OXF, RB, SPF, US, who loaned specimens and made me feel welcome. The research was financed by Coorden-

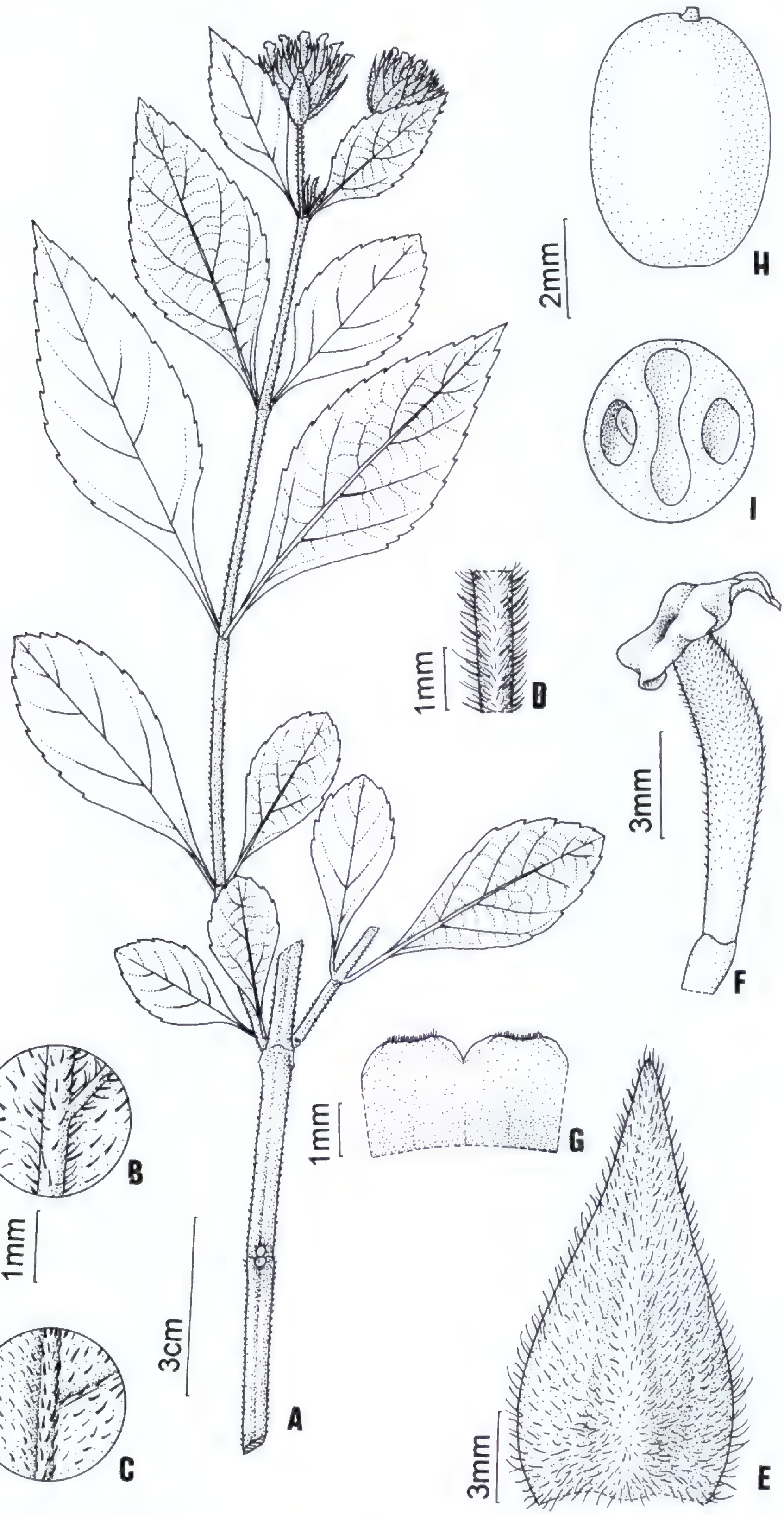


Figure 1. *Lippia magentea* T. Silva. —A. Plant. —B. Leaf, lower surface (detail). —C. Leaf, upper surface (detail). —D. Peduncle, indumentum (detail). —E. Bract, adaxial view. —F. Flower. —G. Calyx. —H. Fruit, intact. —I. Fruit cross section revealing two locules developing. (Drawn from the isotype, *Harley 53635*.)

ação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

Literature Cited

Junell, S. 1934. Zur Gynäceummorphologie und Systematik der Verbenaceen und Labiaten. A.-B. Lundequistska Bokhandeln, Uppsala.

Mori, S. A. 1989. Eastern, extra-Amazonian Brazil. Pp. 428–453 *in* D. G. Campbell & H. D. Hammond (editors), Floristic Inventory of Tropical Countries. The New York Botanical Garden, Bronx.

Silva, T. R. S. 1999. Redelimitação e Revisão Taxonômica do Gênero *Lantana* L. (Verbenaceae) no Brasil. Tese de Doutorado, Universidade de São Paulo, São Paulo.

A New and Endangered Species of *Decaspermum* (Myrtaceae) from East-Central Queensland

Neil Snow
Department of Biological Sciences, University of Northern Colorado, Greeley, Colorado 80639, U.S.A. nsnow@bentley.unco.edu

Gordon P. Guymer
Queensland Herbarium, Brisbane Botanic Gardens Mt. Coot-tha, Mt. Coot-tha Road, Toowong, Queensland 4066, Australia

ABSTRACT. The new species *Decaspermum struckoilicum* N. Snow & Guymer is described from Queensland. It is distinguished from *Decaspermum humile* (G. Don) A. J. Scott in Australia by its narrower and more acute leaves, shorter petioles, and unlobed mature fruits. The new species lacks the "vertical false septum" that has been reported to occur in the middle of each locule between seeds in *Decaspermum*, and which has been used in part to diagnose *Decaspermum* from related genera. Instead, the three seeds that typically occur per locule in the mature fruit are completely surrounded by an encapsulating membrane. Typically, seeds within the membrane are weakly fused and lack any intervening tissue between them. A key is provided to separate the new species from *Decaspermum humile*.

Key words Australia, *Decaspermum*, endangered, Myrtaceae, Myrtinae, Queensland.

Decaspermum J. R. Forster & G. Forster is a genus of approximately 30 species with fleshy fruits in Myrtinae (Myrtaceae) that ranges from Indomalesia to at least Tahiti (Snow, 2000). Relatively little attention has been focused on the genus since the revisionary work of Scott (1979a, 1979b, 1980), apart from a generic transfer by Parnell and Nic Lughadha (1992) and observations by Chang and Miau (1982) regarding its occurrence in China. In Australia the genus is represented by two species, *D. humile* (G. Don) A. J. Scott and the new species described herein, *D. struckoilicum* N. Snow & Guymer.

Descriptions are based primarily on herbarium material (BRI, CANB, NSW) but include observations from wild and cultivated specimens. We use a general lineage concept (de Queiroz, 1998), in which species are hypothesized to represent tokogenetically closed genealogical lineages (Frost & Kluge, 1994; Davis, 1997) diagnosable by one or more characters by ordinary morphological means (Snow, 1997). The characters studied overall are similar to those in Snow and Guymer (1999).

Decaspermum struckoilicum N. Snow & Guymer, sp. nov. TYPE: Australia. Queensland: Port Curtis District, Struck Oil, 6 km E of Mount Morgan, 29°39′S, 150°28′E, 14 Nov. 1987, *N. Hoy s.n.* (holotype, BRI [AQ 455657]; isotypes, BISH, BRI, GREE, K, LAE, MO, NSW). Figure 1.

Decaspermum sp. "Mt. Morgan" in Henderson (1997).

Haec species a *Decaspermo humili* foliis ellipticis latioribus apice acutis non acuminatis supra plerumque hebetatis marginibus planis, petiolo 1.5–4.5 mm longo, hypanthio praecipue basi sericeo, fructa maturitate in sectiona transversali circulari distinguitur.

Erect multi-stemmed shrubs or small trees, up to 4 m tall. Bark smooth to somewhat flaky, gray or brown. Branchlets of current year round, gray to reddish brown, smooth, sparsely short sericeous; oil glands indistinct, sparse to common. Leaves discolorous, matte or slightly glossy above, matte below, decussate, opposite, ± evenly distributed along branches, coriaceous. Leaf axils bearing 2 to several setose, ferrugineous hairs. Petioles glabrous to sparsely sericeous, 1.5–4.5 mm long, glandular when young and becoming somewhat rugulose with age, olive-green to reddish, smooth to channeled above. Leaves elliptic, pinnately nerved, 18–55 × 10–35 mm, base cuneate, apex acute, uppermost tip pointed to mucronate, margins flat; upper surface glabrous, oil glands prominent, visible without magnification or requiring 10× magnification, dense, midvein flush; lower surface glabrous, oil glands prominent without magnification, dense, midrib slightly raised, lateral veins not visible or

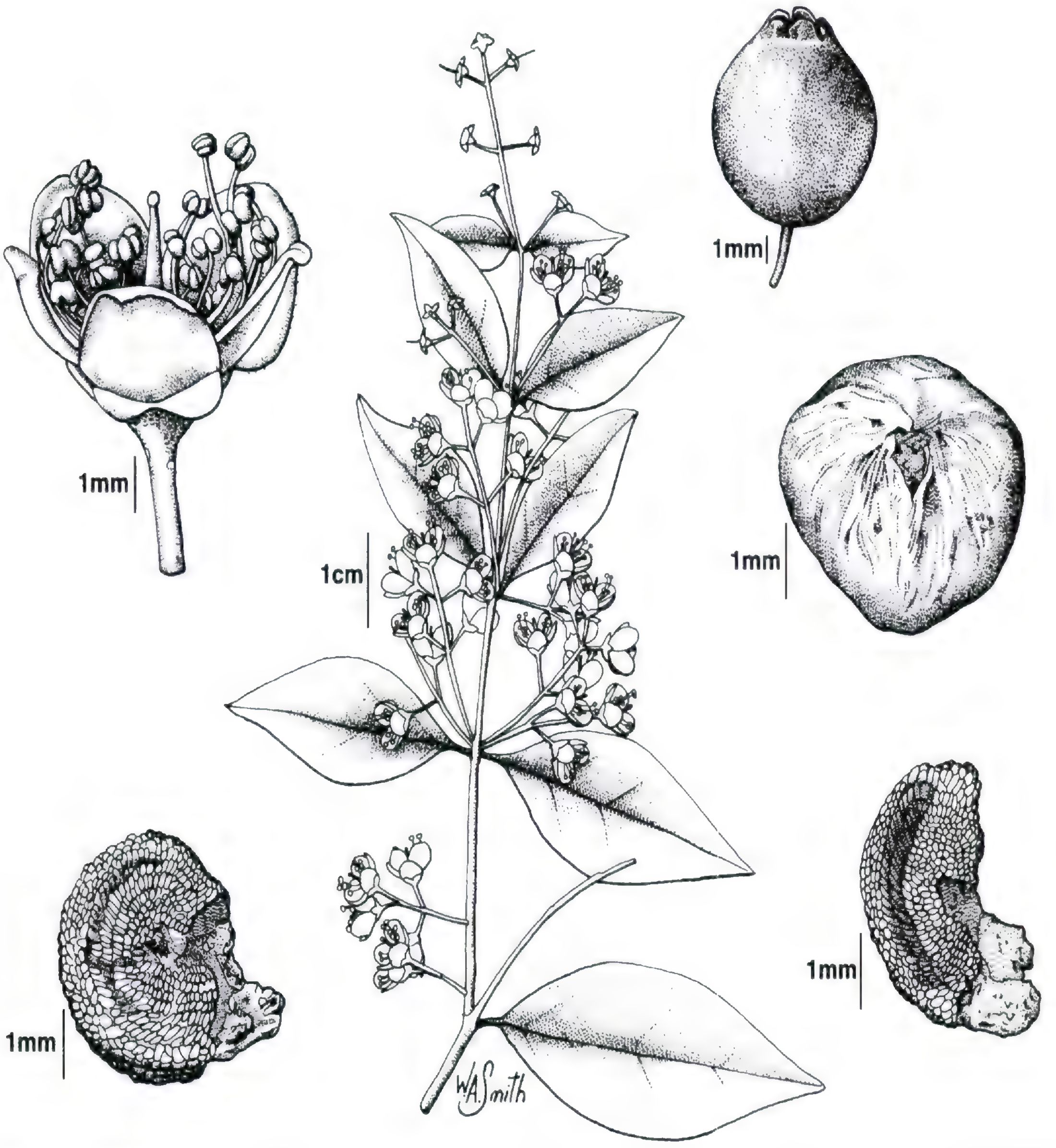


Figure 1. *Decaspermum struckoilicum* N. Snow & Guymer. —Center, flowering branchlet (*D. Hoy 3*). —Top left, flower (*N. Hoy AQ 455657*). —Top right, mature fruit (*D. Hoy AQ 476400*). —Center right, encapsulating membrane of seeds (*D. Hoy AQ 476400*). —Bottom left and right, mature seeds (*D. Hoy AQ 476400*). (All vouchers at BRI.)

indistinct, intramarginal veins not visible or indistinct, up to 1.2 mm from margin. Inflorescence terminal or axillary, solitary or paired, paniculate (botryoid or metabotryoid sensu Briggs & Johnson, 1979), anthopodia occasionally present; peduncles subtending each flower rigid, 2.5–4.5 mm long, sparsely sericeous. Bracteoles 2, linear to narrowly triangular, 1.0–1.4 mm long, 0.3–0.5 mm wide, ascending to erect, shorter than base of sepal lobes, sparsely sericeous, soon deciduous in flower. Hypanthium cupulate, smooth, 1.0–1.7 mm long, sparsely sericeous (particularly at base), tube not extending beyond ovary apex, oil glands common to dense. Calyx lobes 4 or 5 (sometimes both on a single plant), fused proximally beyond ovary, separate in bud, mostly greenish or somewhat petaloid on margins, broadly ovate to rounded, apex obtuse, free portions of lobes 1.2–1.5 mm long, glabrous to sparsely ciliate, glabrous below, persistent in fruit, erect. Petals 4 or 5, yellowish white, widely ovate to oblate, 3.0–3.5 × 2.5–3.5 mm, glabrous to minutely ciliate, glabrous below, oil glands common. Stamens 16 to 25, in 1 to 3 whorls, included, filaments up to 3.5 mm long; staminal disk glabrous;

ovary apex glabrous; anthers subglobose, dorsifixed, versatile, 0.5–0.8 mm long, dehiscing via longitudinal slits, eglandular. Style 2.5–3.5 mm long, glabrous; stigma terete to slightly capitate by virtue of subapical constriction of style. Fruit a soft berry, subglobose to globose, base rounded, up to 7.5 mm long and 8.5 mm wide, glabrous, dark bluish black at maturity. Ovaries 3- to 4-locular; placenta capitate, axile; ovules usually 3(2) per placenta, in 1 horizontal row, the seeds of each locule becoming surrounded by an encapsulating membrane in mature fruit (Snow, 1999, 2000); seeds up to 8 in mature fruit, rounded to somewhat reniform, flattened, dark brown, 2.2–3.7 mm long, adjacent seeds weakly fused, long (= embryonic) axis oriented vertically, outer testa hard, bony; cells of testa relatively large and irregularly elliptic. Embryo slightly curved, oil glands absent, starchy, endosperm absent, hypocotyl relatively thin and not swollen at tip and held on same plane as cotyledons, cotyledons straight, shorter than hypocotyl, folded backward sharply toward hypocotyl.

The specific epithet refers to the town of Struck Oil, around which the new species occurs.

Phenology. Flowering in October and November; fruiting November through February.

Decaspermum struckoilicum is restricted to the small town of Struck Oil and vicinity, roughly 30 km south of Rockhampton in east-central Queensland. It occurs in semi-evergreen vine thickets on reddish or chocolate soils, often in disturbed areas, and at elevations up to 300 m. The new species is only known from six collections and is currently listed as Endangered under the Queensland Nature Conservation Act of 1992. It also should be considered Endangered under IUCN standards following criteria B1 and C2a (Species Survival Commission, 1994). Little is known at the current time regarding the number or sizes of populations or whether the populations are stable. As such, a detailed survey of its status should be a high priority for conservation assessments.

Snow (1999) discussed the inaccuracy of the term "vertical false septum" (Scott, 1979a: 432, 1979b: 59) as a diagnostic character for the genus. The mature fruit of *Decapsermum struckoilicum* has no septum located in the middle of each locule. Rather, the three seeds that typically occur per locule in the mature fruit are completely encapsulated by a moderately thick tissue layer, but no tissue intervenes between seeds in an individual locule. Snow (1999) tentatively designated this tissue as the encapsulating membrane (see Fig. 1). Adjacent seeds in each locule are weakly connate but are separated easily. When the encapsulating membrane is removed from the mature fruit, the remaining hypanthium wall is thin, suggesting its tissue may be derived at least partially from the one or more layers of the ovary wall. A more detailed anatomical study of this variation in tissue structure is needed and might enlighten relationships in *Decaspermum* (Snow, 1999).

Key to Australian Species of *Decaspermum*

1. Leaves elliptic, apex acute to mucronate, upper surface mostly matte, margins flat; petioles 1.5–4.5 mm long; hypanthium sericeous mostly at base; mature fruit lacking constrictions along locular walls in cross section . . . . . *D. struckoilicum*
1′. Leaves narrowly elliptic, apex acuminate, upper surface mostly glossy, margins slightly recurved; petioles (3–)4–7 mm long; hypanthium sericeous throughout; mature fruit somewhat constricted along locular walls in cross section . . . . *D. humile*

Paratypes. AUSTRALIA. **Queensland:** Port Curtis District, Struck Oil, 6 km E of Mt. Morgan, 23°39′S, 150°28′E, 18 Nov. 1989, *Forster PIF 4984* (BRI, L), *Hoy s.n.* (BRI AQ 476400 + spirits, MEL, QRS); Struck Oil via Mt. Morgan, 23°4-′S, 150°2-′E, 22 Oct. 1984, *Hoy 3* (BRI); Struck Oil, property of D. McDonald, 23°37′S, 150°27′E, 7 Feb. 1997, *Forster et al. PIF20268* (BRI).

Acknowledgments. We thank the curators of BRI, CANB, and NSW for loans of specimens; Les Pedley and Roy Gereau for assistance with the Latin diagnosis; Will Smith for the illustration; and P. Wilson and L. Landrum for constructive reviews. Research was supported by grants from the Australian Biological Resources Study from 1997 to 1999. The senior author thanks the University of Northern Colorado for granting a leave of absence to finish this project.

Literature Cited

Briggs, B. A & L. A. S. Johnson. 1979. Evolution in the Myrtaceae—Evidence from inflorescence structure. Proc. Linn. Soc. New South Wales 102: 157–256.

Chang, H. T. & R. H. Miau. 1982. Additions to the Myrtaceous flora of China. Acta Bot. Yunnan. 4: 17–25.

Davis, J. I. 1997. Evolution, evidence, and the role of species concepts in phylogenetics. Syst. Bot. 22: 373–403.

Frost, D. R. & A. G. Kluge. 1994. A consideration of epistemology in systematic biology, with special reference to species. Cladistics 120: 259–294.

Henderson, R. J. F. 1997. Queensland Plants: Names and Distribution. Queensland Department of Environment, Brisbane.

Parnell, J. & E. Nic Lughadha. 1992. Notes on Thai Myrtaceae. Kew Bull. 47: 703–706.

Queiroz, K. de. 1998. The general lineage concept of species and the defining properties of the species category. Pp. 49–89 *in* R. A. Wilson (editor), Species: New Interdisciplinary Essays. MIT Press, Cambridge, Massachusetts.

Scott, A. J. 1979a. A revision of *Rhodamnia* (Myrtaceae). Kew Bull. 33: 429–459.
———. 1979b. The Austral-Pacific species of *Decaspermum* (Myrtaceae). Kew Bull. 34: 59–67.
———. 1980. A synopsis of *Decaspermum* (Myrtaceae) in Southeast Asia and China. Kew Bull. 35: 403–411.
Snow, N. 1997. Application of the phylogenetic species concept: A botanical monographic perspective. Austrobaileya 5: 1–8.
———. 1999. Notes on generic concepts in *Rhodomyrtus*, *Archirhodomyrtus*, *Decaspermum*, and *Pilidiostigma* (Myrtaceae). Austral. Syst. Bot. Soc. Newslett. 99: 5–7.
———. 2000. Systematic conspectus of Australasian Myrtinae (Myrtaceae). Kew Bull. 55: 647–654.
——— & G. P. Guymer. 1999. Systematic and cladistic studies of *Myrtella* F. Muell. and *Lithomyrtus* F. Muell. (Myrtaceae). Austrobaileya 5: 173–208.
Species Survival Commission. 1994. IUCN Red List Categories. IUCN Council, Gland.

Rhodamnia longisepala (Myrtaceae): An Endangered Species from Northeastern Queensland, Australia

Neil Snow

Department of Biological Sciences, University of Northern Colorado, Greeley, Colorado 80639, U.S.A. nsnow@bentley.unco.edu

A. J. Ford

Tropical Forest Research Centre, CSIRO Sustainable Ecosystems, PO Box 780, Atherton, QLD 4883, Australia

B. Koblitz

Department of Biological Sciences, University of Northern Colorado, Greeley, Colorado 80639, U.S.A.

ABSTRACT. *Rhodamnia longisepala* N. Snow & A. J. Ford is described from the Windsor Tableland region of northeastern Queensland, Australia. All known collections occur in the Chowchilla Logging Area of State Forest Reserve 144. Since only nine plants are known over an area of 1 km², the species is considered highly vulnerable. The new species is distinguished from others in *Rhodamnia* by the persistent and erect subulate sepal lobes of the fruit. The fruit droops at maturity, is covered by densely villous to hirsute hairs, and lacks a reddish stage en route to its purplish black mature color. Domatia are present on the abaxial leaf surface where the major lateral nerves join the midnerve near the petiole. *Rhodamnia longisepala* somewhat resembles *R. rubescens* in leaf morphology and pubescence, but the latter species is far more common and is distributed from southeastern Queensland to southeastern New South Wales.

Key words: Australia, domatia, endangered, essential oils, Myrtaceae, Queensland, *Rhodamnia*.

The genus *Rhodamnia* Jack consists of about 30 shrubby to arborescent species and ranges from southeastern Asia to Australia and New Caledonia (Scott, 1979; Guymer & Jessup, 1986; Guymer, 1988; Snow, 2000). Snow and Guymer (1999) recently described a rare new species, *R. angustifolia*, from southeastern Queensland.

Separate revisions of the Australian and Malesian species are currently in progress by the first author, and will include additional new species from Queensland and New Guinea. After initiating the revision of the Australian species it was soon evident from three undetermined specimens that an undescribed species occurred in the Windsor Tableland region of northeastern Queensland. The second author recently made detailed observations of the species in its natural habitat and secured additional collections. In light of its rarity and immediate conservation concern, we are expediting publication of this species prior to the complete revisions of other Australian and Malesian *Rhodamnia*.

Herbarium specimens and living material in the field were measured using a character format similar to Snow and Guymer (1999). Descriptive terminology of shapes follows the Systematics Association Committee (1962), whereas terminology of pubescence follows Stearn (1992). We are citing all known specimens given its rarity and cogent need to document its distribution for more detailed conservation assessments (Snow & Keating, 1999).

Rhodamnia longisepala N. Snow & A. J. Ford, sp. nov. TYPE: Australia. Queensland: Cook District, State Forest Reserve 144, Chowchilla Logging Area, 500 m along old westerly logging track, 16°17′S, 145°05′E, 840 m, 26 July 2000, *A. Ford 2392* (holotype, BRI; isotypes, CANB, GREE [+ photo of fruiting branch], K, L, MEL, MO, NSW, QRS [+ spirit], SYD). Figure 1.

Rhodamnia rubescenti affinis sed lobis sepalis persistentibus erectisque quum fructificantibus, et fructibus pilis densis differt.

Single- to multi-stemmed large shrubs or trees, 2.5–5 m tall, spreading to erect. Bark of main trunk stringy, ± flakey, somewhat fissured, deep reddish brown. Branches of current year's growth rounded,

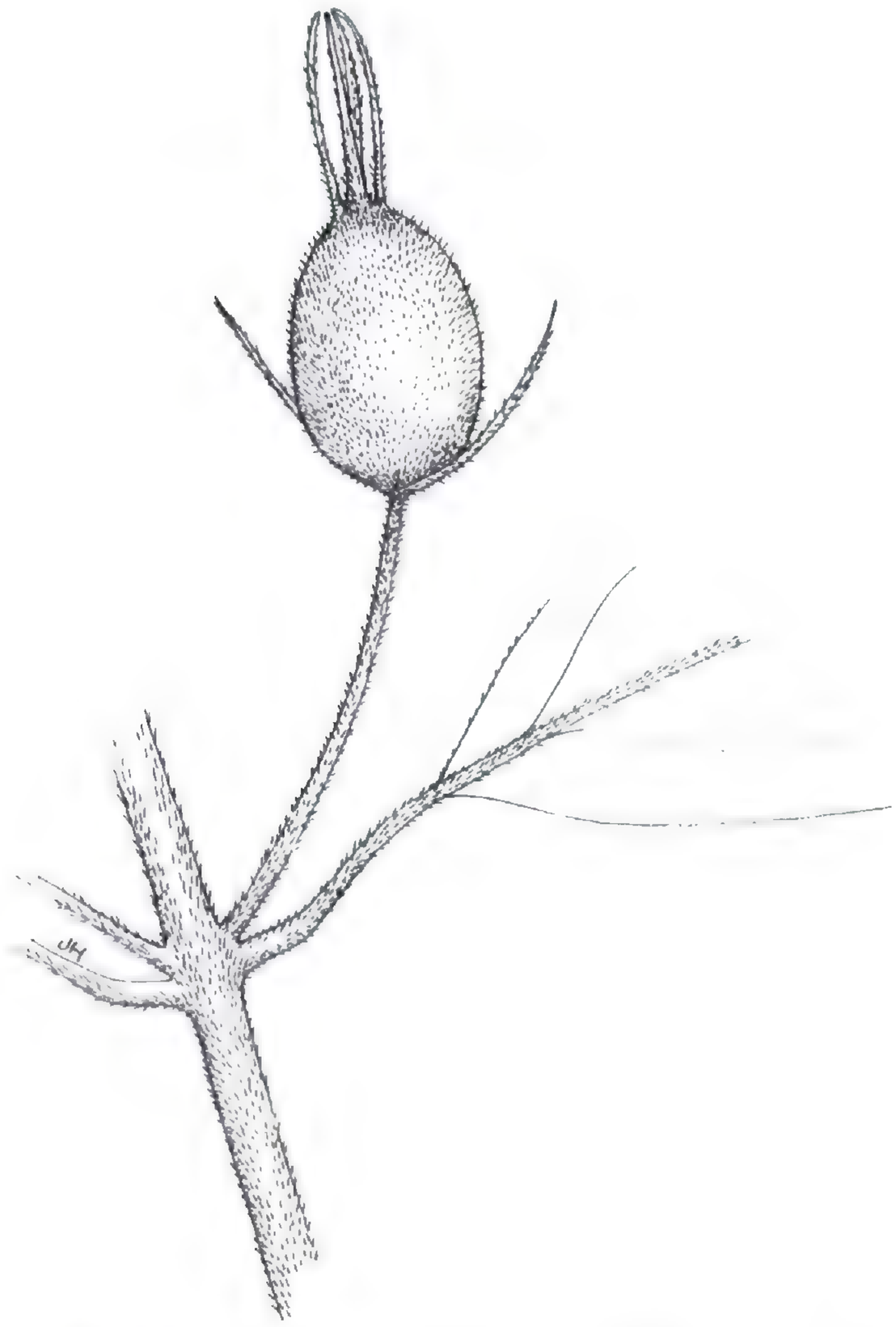


Figure 1. *Rhodamnia longisepala* N. Snow & A. J. Ford. Maturing fruit showing subulate sepal lobes and long bracteoles (from the type, *A. Ford 2392*). Excluding sepal lobes, the fruit is slightly less than 1 cm long. Although shown upright, the fruit is typically deflexed on the branches.

not winged, tomentose or hirsute, greenish to brownish, bark smooth, eglandular. Stipules of two to several ferrugineous setose hairs, often obscured by other pubescence. Petioles 3–7 mm long, often channeled above somewhat toward apex (less so basally), eglandular. Leaves opposite, decussate, not clasping, discolorous, matte above and below, velvety, triplinerved (perfect or imperfect suprabasal acrodromous [Hickey, 1973]), elliptic to ovate, 35–86 × 20–42 mm, base cuneate to rounded, apex acute to acuminate, ultimate tip (if present) mucronate, margins flat; adaxial surface somewhat sparsely to moderately villous to hispid, the hairs mostly arising directly from veins (of all orders) and often red at base, oil glands visible with magnification, common to dense with 1 to 4 glands per areole (Hickey, 1973), midvein impressed; abaxial surface villous to hispid, densely so on midvein, decreasingly so on increasing orders of venation, veins all prominently raised, 3.5–6.2 mm from margin at midpoint, secondary veins indistinct below but prominent in upper half, intramarginal vein absent or at best poorly formed, irregular and looping, 1.0–1.8 mm from margin at midpoint, gland density as for adaxial surface. Inflorescence of monads in leaf axils, anthopodia and metaxyphylls absent (Briggs & Johnson, 1979), peduncles rigid, 8–12 mm long, densely villous to hirsute. Bracteoles two, linear, not foliaceous, 5–7 × 0.3–0.4 mm, irregularly flexuous or incurved above, apex exceeding base of sepal lobes, villous to hirsute, sometimes persistent in fruit. Hypanthium urceolate, 2.7–3.2 mm long, oil glands common (but often faint), densely villous to hirsute. Sepals 4, often with stipule-like glands on either side of base, distinct in bud, greenish, lobes 4.5–6.5 mm long, linear to narrowly triangular, apex acute, villous to hirsute, persistent and erect (and more so in fruit). Petals 4, alternate with sepals, white (drying very light orange-brown), 4.5–5.5 × 3.0–3.7 mm, ovate to widely ovate, adaxial surface glabrous with some marginal hairs at apex, abaxial surface glabrous with some marginal hairs toward apex, oil glands sparse to common. Stamens 40 to 50, multiseriate, included, folded toward center in bud; filaments 2.6–3.8 mm long, staminal disk glabrous, ovary apex shortly hairy; anthers subglobose to globose, basifixed, 0.5–0.6 mm long, dehiscing via longitudinal slits, apical gland present. Ovary 1-locular, placentas 2, parietal, ovules 2 or 3 per placenta. Style 4.8–5.2 mm long, straight or curved toward apex, glabrous, stigma terete. Fruit a berry, ellipsoid, rounded at base, 8.5–10 mm long, 5.5–7 mm diam., densely villous to hirsute, maroon to purplish black at maturity. Seeds 2, globular to reniform, 3.5–3.8 mm long, one surface somewhat convex, the other somewhat concave, testa hard, light brown, operculum present. Embryos apparently aborting or highly shriveled.

Flowering occurs from June through August; fruiting occurs from July through September. The elevational range is 840–950 m.

Rhodamnia longisepala is presently known in dry rainforest, Type 6, complex notophyll vineforest (Tracey, 1982) on granitic substrates. Canopy dominants include *Agathis robusta* (C. Moore ex F. Mueller) F. M. Bailey, *Aleurites moluccana* (L.) Willdenow, and *Argyrodendron polyandrum* L. S. Smith. Common small trees include *Dinosperma melanophloia* (C. T. White) T. G. Hartley, *Canthium lamprophyllum* F. Mueller, *Croton insularis* Baillon, *Austromyrtus bidwillii* (Bentham) Burret, *Pouteria myrsinoides* (A. Cunningham ex Bentham) Baehni, *Elattostachys microcarpa* S. T. Reynolds, *Rhodamnia costata* A. J. Scott, *Acronychia laevis* J. R. Forster & G. Forster, *A. imperforata* F. Mueller, and

Diospyros pentamera (Woolls & F. Mueller) F. Mueller. Type 6 forests can be found on basalt, granite, rhyolite, and metamorphics. In northeastern Queensland, this type of rainforest is characterized by the high representation and proportion of southern elements more akin to the rainforests of southeastern Queensland and northeastern New South Wales. The exceptionally dry phase of the dry season appears to be the common denominator ecologically between the Type 6 rainforests in northeastern Queensland and those in southeast Queensland and northern New South Wales. The dry Type 6 forests in northeastern Queensland harbor few local endemics such as *Elaeocarpus coorangooloo* J. F. Bailey & C. T. White, despite their relatively wide distribution in the northeast from the Cooktown region south to the Kirrama area (Tracey, 1982). This is in marked contrast to the wetter rainforests of northeastern Queensland, which are home to numerous local endemics.

Neither the crushed leaves nor the flowers of *Rhodamnia longisepala* emit a particularly distinct aroma (A. Ford, pers. obs. 2000), although some species such as *R. australis* A. J. Scott have strongly scented flowers. Small domatia occur at the junction of the midnerve and primary lateral nerves on the abaxial leaf surface. One specimen (*Ford 1953*) has several small, undetermined golden brown mites or insects about 0.4 mm long preserved in the pubescence at the entry to the domatia.

Rhodamnia longisepala shows considerable variation in its growth form and vigor. Although speculative on our part, this may reflect the disturbance history of the site, particularly that due to logging activities. In places where disturbance from logging has ceased for adequate time to allow the canopy to grow back to its approximate undisturbed density, plants of *R. longisepala* had a single stem that had decayed over time, but which had coppiced (often profusely so). The stems of such plants are lanky and often leaning. In contrast, plants in more recently disturbed sites with a broken canopy are single-stemmed, erect, with considerable branching, and lack coppicing. Growth of *R. longisepala* thus may be stimulated by mild disturbances, particularly those that increase the total amount of light.

From existing herbarium specimens it appears that *R. longisepala* was first collected in 1990 by Gary and Nada Sankowsky (*GS+ 1110*). This and subsequent collections at BRI were erroneously placed under *R. rubescens* (Benth.) Miq., even though good flowering material was present. It is surprising that *R. longisepala* was never apparently collected by employees of the former Atherton Forestry Office in the vicinity of the currently known population, given their frequent collecting in that general area. It appears that all collections of *Forster* and *Sankowsky* (see below) came from a single plant, given recent personal communications with these collectors.

Rhodamnia longisepala most closely resembles *R. rubescens* but differs from the latter species by its persistent subulate sepal lobes, which remain erect in fruit and are much longer than those of *R. rubescens*, the 4- to 6-ovuled ovary, the lack of a reddish stage during the maturation of fruit (although it can become brownish when dried), and the dense covering of villous hairs on the mature fruit (Table 1). *Rhodamnia longisepala* superficially resembles *R. pauciovulata* Guymer (1988), which has shorter leaves, shorter calyx lobes and petals, and glabrous fruits. The dull, lime-colored leaves with their villous to hirsute pubescence should help distinguish *R. longisepala* from closely related species. The current geographical ranges of *R. rubescens* and *R. pauciovulata* are disjunct from *R. longisepala*, making it further unlikely they will be confused. *Rhodamnia longisepala* was not known during preparation of the interactive key to Australian Tropical Rain Forest Trees and Shrubs (Hyland et al., 1999). A complete key to the Australian and Malesian species of *Rhodamnia*, including additional new species from Queensland and New Guinea, is in preparation.

Rhodamnia longisepala is the second rare species of the genus recently described from Queensland (Snow & Guymer, 1999). Currently, *R. longisepala* is only known from nine specimens over an area of approximately 1 km^2 on the Windsor Tableland of northeastern Queensland, in the Chowchilla Logging Area of State Forest Reserve 144. As such, it is presently even more rare than the 19 known individuals of *R. angustifolia* N. Snow & Guymer (Snow & Guymer, 1999), and must be considered Endangered by both the IUCN Species Survival Commission (1994) and the Queensland Nature Conservation Act of 1992. Additional fieldwork to better document its range and relative abundance should be a high priority in the near future.

Essential oil profiles have been assayed for Australian *Rhodamnia* (Brophy et al., 1997). One collection (*Forster PIF 13699*) now recognized as *R. longisepala* was incorrectly determined (Brophy et al., 1997) as *R. rubescens*. Brophy (pers. comm., 2000) indicates that the sample of *R. longisepala* is qualitatively similar to two collections of *R. rubescens* in its leaf oil profiles. The main components of *R. longisepala* are α-pinene (40–51% of volatile oils); β-caryophyllene (10–13%), and globulol and

Table 1. Vegetative and floral differences among *Rhodamnia longisepala*, *R. pauciovulata*, and *R. rubescens*. Dimensional measurements for *R. longisepala* are tentative due to limited fertile material. Some data obtained from Guymer (1988).

	R. longisepala	*R. pauciovulata*	*R. rubescens*
Leaf pubescence, adaxial	moderately villous to hispid	tomentose with longer hairs interspersed	tomentose to villous
Domatia on leaves	present at junction of abaxial lateral nerves and midnerve	absent	absent
Inflorescence type	monad	monad	monad, triad, botryoid
Hypanthium length mm (to base of sepal lobes)	2.7–3.2	1.0–1.5	1.8–2.6
Sepal lobe length in flower (mm)	4.5–6.5	1.5–2.0	2.0–2.3
Sepal lobe persistence in fruit	persistent	persistent	deciduous
Petal length (mm)	4.5–5.5	3.0–3.6	4.0–4.5
Ovule number per placenta	2 or 3	4 to 6	35 to 80
Fruit length (mm)	8.5–10	4.5–5.5	5–11
Fruit width (mm)	5.5–7	5–7	10–12
Fruit indumentum	densely villous to hirsute	glabrous	sparsely sericeous
Reddish stage during fruit maturation	absent	absent	present

viridifloral (3–5%), and spathulenol (7–9%). The latter two compounds are present in much smaller amounts than in the two samples of *R. rubescens*, which has α-pinene of approximately 82%. More sampling is needed to establish whether these differences are significant.

The specific epithet *longisepala* refers to the long sepal lobes relative to all other species in the genus.

Paratypes. AUSTRALIA. **Queensland:** Cook District, Mount Windsor Tableland, State Forest Reserve 144, Aleurites area, 16°17′S, 145°05′E, 7 July 1997, *A. Ford* 1953 (QRS); Aleurites site, 16°17′34″S, 145°05′21″E, 10 July 1995, *P. I. Forster PIF17227 & S. J. Figg* (BRI, QRS); Windsor Tableland, 16°17′S, 145°03′E, 20 July 1990, *G. Sankowsky 1110 & N. Sankowsky* (BRI, DNA [not seen]); Chowchilla Logging Area, about 800 m into rain forest, 16°17′S, 145°05′E, 30 Aug 1998, *A. Ford 2095* (BRI, QRS); 9 km past Spencer Ck. crossing, 16°18′E, 145°05′S, 24 July 1993, *P. I. Forster PIF13699 et al.* (BRI).

Acknowledgments. Permits to traverse and collect in State Forest Reserve 144 were issued by the Department of Natural Resources. Jenny Holmes (QRS) kindly provided the line drawing. Joe Brophy (Univ. New South Wales) made available unpublished vouchered data analyses on essential oils from *PIF 13699* (BRI). Peter Bostock kindly provided additional collection data from BRI on short notice. We thank the curators of BRI and QRS for providing loan material and Bryan Simon for providing the Latin diagnosis. The manuscript was improved by suggestions from Peter Wilson and Les Landrum, whose ongoing assistance in many research projects is greatly appreciated. The first author thanks the Sponsored Programs and Academic Research Center (SPARC) at the University of Northern Colorado (UNC) for a Summer Faculty Research Fellowship in 2000, which supported this research. The second author thanks Chris Margules for support and encouragement. The third author thanks the Graduate School at UNC for a Summer Graduate Fellowship during 2000.

Literature Cited

Briggs, B. G. & L. A. S. Johnson. 1979. Evolution in the Myrtaceae—Evidence from inflorescence structure. Proc. Linn. Soc. New South Wales, Ser. 2, 102: 157–256.

Brophy, J. J., R. J. Goldsack & P. I. Forster. 1997. The leaf essential oils of the Australian species of *Rhodamnia* (Myrtaceae). Flav. Fragr. J. 12: 345–354.

Guymer, G. P. 1988. *Rhodamnia pauciovulata*, a new species of Myrtaceae from Queensland. Austrobaileya 2: 515–516.

——— & L. W. Jessup. 1986. New species of *Rhodamnia* Jack (Myrtaceae) from Australia. Austrobaileya 2: 228–234.

Hickey, L. J. 1973. Classification of the architecture of dicotyledonous leaves. Amer. J. Bot. 60: 17–33.

Hyland, B. P. M., T. Whiffin, D. C. Christophel, B. Gray, R. W. Elick & A. J. Ford. 1999. Australian Tropical Rainforest Trees and Shrubs. CSIRO Publishing, Collingwood, Australia.

Scott, A. J. 1979. A revision of *Rhodamnia* (Myrtaceae). Kew Bull. 33: 429–459.

Snow, N. 2000. Systematic conspectus of Australasian Myrtinae (Myrtaceae). Kew Bull. 55: 647–654.

——— & G. P. Guymer. 1999. *Rhodamnia angustifolia* (Myrtaceae), a new and endangered species from southeastern Queensland. Austrobaileya 5: 421–426.

——— & P. L. Keating. 1999. The relevance of specimen citations to conservation. Conservation Biol. 13: 943–944.

Species Survival Commission. 1994. IUCN Red List Categories. IUCN Council, Gland.

Stearn, W. T. 1992. Botanical Latin, 4th Ed. Timber Press, Portland, Oregon.

Systematics Association Committee for Descriptive Biological Terminology. 1962. I. Terminology of simple symmetrical plane shapes (chart 1). Taxon 11: 145–156.

Tracey, J. G. 1982. The Vegetation of the Humid Tropical Region of North Queensland. CSIRO, Melbourne.

Notes on *Agalinis* (Scrophulariaceae) from Brazil

Vinicius Castro Souza, Samira Ismael Elias and Ana Maria Giulietti
Herbário ESA, Departamento de Ciências Biológicas, Escola Superior de Agricultura "Luiz de Queiroz", Caixa Postal 9, 13418-900, Piracicaba, SP, Brasil

ABSTRACT. Two new species of *Agalinis* Rafinesque, *A. itambensis* V. C. Souza & S. I. Elias and *A. nana* S. I. Elias & V. C. Souza, are described and illustrated. The new combination *A. schwackeana* (Diels) V. C. Souza & A. M. Giulietti is also made.

Key words: *Agalinis*, Brazil, Scrophulariaceae.

Agalinis Rafinesque comprises approximately 60 species including annual and perennial herbs and shrubs. The genus occurs from the coastal plain of Nova Scotia in Canada, to the puna communities above 3000 m in the Andes of South America. North and Central America are represented by about 35 species, and in South America approximately 25 species occur (Canne-Hilliker, 1988). Of these 25, 14 occur in Brazil. Species from North America are herbaceous while shrubs and mainly subshrubs are common in South America. Some authors, such as Judd et al. (1999), included *Agalinis* and other parasitic and hemiparasitic Scrophulariaceae in Orobanchaceae, based on recent phylogenetic studies.

Most Brazilian species occur in the southeast and south, mainly in higher elevations of Minas Gerais (*campos rupestres*), generally restricted to certain mountain ridges or groups of ridges. One of the species, *A. hispidula* (Martius) D'Arcy, has a much broader distribution, ranging from the Antilles region to about 20°S latitude.

Observations in the field were extremely important, because these taxa lose some of their important features in the preparation of herbarium specimens. Most of the species are separable by measurable features; however, when they are observed in nature their delimitation becomes easier by the three-dimensional form of the corolla. These observations were also important in relation to the resemblance between *Agalinis* and *Esterhazya*, which was emphasized by Souza (1996).

Bentham (1846) separated both genera by the corolla color, affirming that it would be red in *Esterhazya* and violet or rose in *Agalinis*. Schmidt (1862) distinguished them mainly on the basis of corolla shape: *Esterhazya* with tubular-funnelform flowers and *Agalinis* with ventricose-tubular flowers. Other authors like Wettstein (1891), Barroso (1952), and Ichaso and Barroso (1970) differentiated *Agalinis* and *Esterhazya* only on the basis of stamen position (included in *Agalinis* and exserted in *Esterhazya*). Souza (1996) recognized the genera as distinct because of the stamen position (included in *Agalinis* and exserted in *Esterhazya*) and the anther indumentum (glabrous in *Agalinis* and villous in *Esterhazya*), but at the same time he pointed out the presence of intermediate species between both genera, such as *A. angustifolia* (Martius) D'Arcy.

Therefore, the objective of this paper is to contribute to the systematics of *Agalinis* in Brazil and to the morphological delimitation of species.

Agalinis itambensis V. C. Souza & S. I. Elias, sp. nov. TYPE: Brazil. Minas Gerais: Santo Antônio do Itambé, subida do Pico do Itambé, 1500 m altitude, 18°24′05.6″S, 43°19′01.9″W, 7 Mar. 1998, *V. C. Souza, J. P. Souza, L. Capellari, Jr., S. I. Elias & W. Forster 21114* (holotype, ESA; isotypes, BHCB, SPF). Figure 1.

Haec species affinis est *Agalini ramosissimae* (Bentham) D'Arcy sed pedicellis longioribus, calyce laciniis brevioribus et capsula duabus valvis differt.

Subshrubs 30–70 cm tall, the stems erect. Twigs terete to slightly 4-angled, puberulent, except below the leaves glabrescent; internodes 4–16 mm long. Leaves opposite, sessile, 1–2.2 × 0.1–0.2 cm, linear, apex acute, base acute, margin entire, straight, involute when dry, 1-nerved, erect or incurved, subcoriaceous, puberulent at the base and along the midvein. Flowers in polytelic synflorescences; pedicel glabrous, erect to patent, 1.5–2.4 cm long; calyx tube 4–7 mm long, ca. 4 mm wide at the mouth, cylindrical-campanulate; calyx teeth shortly triangular, 0.5(–1) mm long, internally puberulent, externally glabrous, margin sometimes short and sparsely ciliate. Corolla magenta, with nectar guides of two cream lines and purple spots, funnelform-cylindrical, externally villous, internally pubescent at level of stamen insertion, 1.6–3.0 cm long, ca. 1.3 cm wide at the mouth; lobes very broadly ovate, apex emarginate or rounded, patent, 4–8 × 5–9 mm, margin ciliate. Dorsal stamens

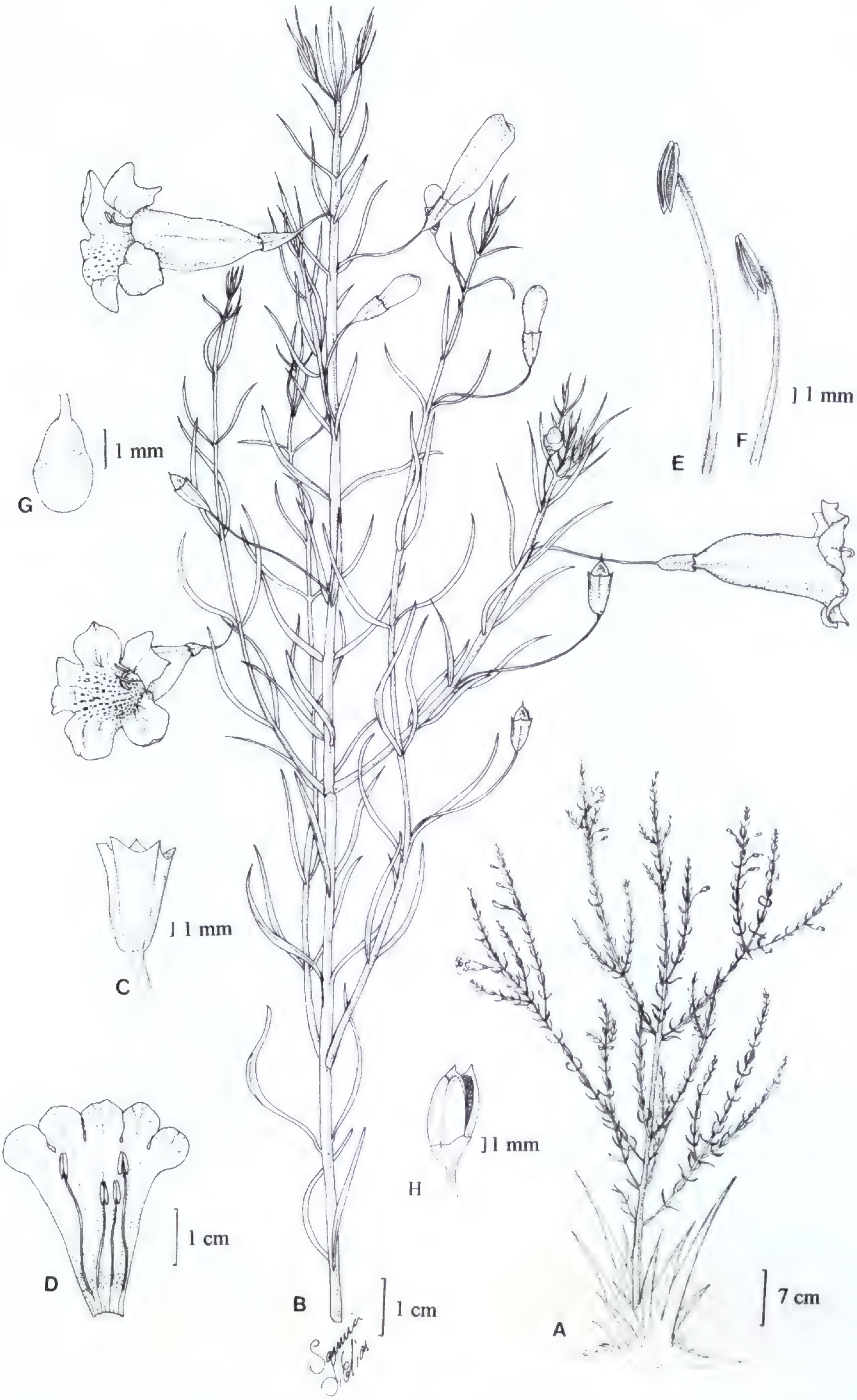


Figure 1. *Agalinis itambensis* V. C. Souza & S. I. Elias. —A. Plant seen among other equitant-leaved plants at base.—B. Branch. —C. Calyx. —D. Corolla and androecium. —E. Dorsal stamen. —F. Ventral stamen. —G. Ovary. —H. Fruit. Based on *V. C. Souza* et al. *21114* (ESA).

reaching the corolla mouth; filaments villous at the apex and the base; dorsal stamens with filaments 1.6–2.2 × 0.05 cm; ventral stamens with filaments 1.0–1.5 × 0.05 cm; anthers 0.5–0.6 × 0.15 cm, apex acute, base mucronulate, villous at the stomial region, anther cells parallel, equal in length. Ovary glabrous, pyriform, ca. 4 × 2.5 mm; style glabrous, terete, ca. 2 × 0.05 cm, apex incurved; stigma entire, papillate, slightly concave. Capsule narrowly ellipsoid to oblate, apex acute to rounded, 8–10 × 4–5 mm, opening by 2 valves. Seeds brown, obovoid, ca. 1 × 0.5 mm, testa reticulate-inflated, reticules approximately isodiametric.

Agalinis itambensis is similar in appearance to *A. ramosissima* (Bentham) D'Arcy, from which it can be distinguished by its longer pedicels, shorter calyx teeth, and by the manner of capsule dehiscence. Pedicels are much longer in *A. itambensis* (1.5–2.4 cm) than in *A. ramosissima* (0.6–0.8 cm). However, calyx teeth are longer in *A. ramosissima* (0.6–0.9 cm) than in *A. itambensis* (0.05–0.1 cm). Capsule valves are fewer (two) in *A. itambensis* than in *A. ramosissima* (four).

This species also resembles *A. angustifolia* in its flower size, pedicel length, leaf shape and length, as well as in its habit. In *A. angustifolia* flowers are purple with a tubular-funnelform corolla with reflexed lobes and apiculate calyx teeth. The new species has magenta flowers with a cylindrical corolla with patent lobes and triangular calyx teeth. Stamens in *A. itambensis* just reach the corolla mouth but reach or mostly exceed the corolla mouth in *A. angustifolia*. Capsules are ellipsoidal with two valves in *A. itambensis*; capsules are ovoid with four valves in *A. angustifolia*.

This species is known only from the type locality, in Serra do Itambé, Minas Gerais, in a *campo rupestre* area.

Paratypes. BRAZIL. **Minas Gerais:** all from Santo Antônio do Itambé, on the basis of Serra do Itambé, 18 Mar. 1963, *M. Magalhães 18922* (HB); towards Pico do Itambé, 2050 m altitude, 18°24′S, 43°21′W, 8 Oct. 1975, *A. Furlan, L. Rossi & N. Hensold CFSC 3062* (ESA, SPF).

Agalinis nana S. I. Elias & V. C. Souza, sp. nov. TYPE: Brazil. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra, 28 Mar. 1999, *S. I. Elias & G. S. Rolim 325* (holotype, ESA; isotype, HUFU). Figure 2.

Haec species affinis est *Agalini brachyphyllae* (Chamisso & Schlechtendal) D'Arcy sed calyce lobis longioribus et foliis linearibus differt.

Herbs or subshrubs 7–30 cm tall, the stems decumbent or sometimes erect. Twigs terete to slightly 4-angled, puberulent, except at the region below the leaves glabrescent; internodes 4–8 mm long. Leaves opposite, sessile, 1.0–2.3 × 0.1–0.2 cm, linear, apex acute, base acute, margin entire, straight, involute when dry, 1-nerved, erect or incurved, subcoriaceous, glabrous or puberulent at the base. Flowers in polytelic synflorescences; pedicel glabrous, erect, ca. 2 mm long; calyx tube 4–6 mm long, ca. 3 mm wide at the mouth, glabrous, cylindrical-campanulate; calyx teeth triangular, 3–8 mm long, ca. 2(–4) mm wide at the base, internally and externally glabrous. Corolla magenta, with nectar guides of two cream lines and purple spots, funnelform, externally villous, internally densely villous, 1.5–2.0 cm long, 5–9 mm wide at the mouth; corolla lobes patent, very broadly obovate or broadly elliptic, apex rounded, less often obtuse, 6–7 × 5–8 mm, margin ciliate. Stamens included; filaments villous at the apex; dorsal stamens with filaments 6–9 × 0.5 mm, ventral stamens with filaments 4–6 × 0.5 mm; anthers ca. 2 × 1 mm, apex acute, base mucronulate, sparsely villous along the stomial region, anther cells slightly divaricate, equal in length. Ovary glabrous, ovoid, ca. 2.5 × 2 mm; style glabrous, terete, ca. 10 × 0.2 mm; stigma entire, incurved, hispid. Capsule ellipsoid to subglobose, apex slightly emarginate, 6–8 × 4–5 mm, opening by 2 valves. Seeds brown, broadly obovoid, testa with reticulate ornamentation, reticules approximately isodiametric.

Agalinis nana resembles *A. brachyphylla* (Chamisso & Schlechtendal) D'Arcy, from which it can be distinguished by its habit, calyx teeth length, and leaf shape. *Agalinis brachyphylla* is an erect plant with short calyx teeth (1–2 mm long) and more or less elliptical leaves. The new species is a decumbent plant with linear leaves and longer calyx teeth (3–8 mm long).

Observations of *A. nana* in the field provided important diagnostic characters. The majority of plants are small, and because of their decumbent habit they often remain obscured by grasses and are not easily found. Also, nectar guides are very different from other species: in addition to their presence in the tube, purple spots are also extended beyond the lower lobes.

This species is known only from the type locality, in Serra da Canastra, Minas Gerais, in a *campo rupestre* area.

Paratypes. BRAZIL. **Minas Gerais:** all from São Roque de Minas, between Piumhi and Araxá, Parque Nacional da Serra da Canastra, 21 Feb. 1978, *G. J. Shepherd, J. Semir, J. B. Andrade & P. R. Salgado 7158* (UEC); Parque Nacional da Serra da Canastra, 15 Apr. 1995, *J. N. Nakajima, R. Romero & F. A. G. Guilherme 808* (ESA); Parque Nacional da Serra da Canastra, Chapadão Dia-

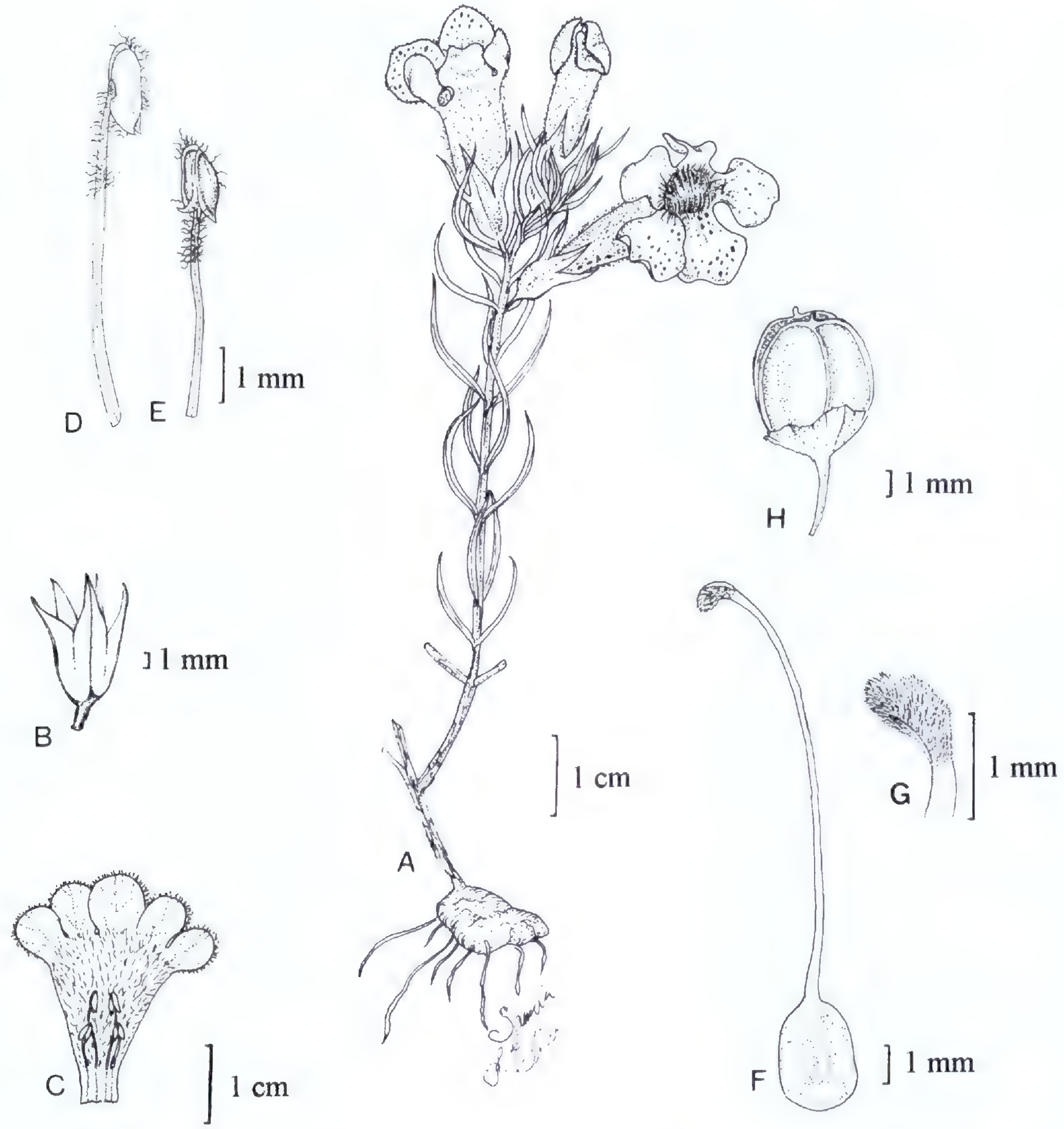


Figure 2. *Agalinis nana* S. I. Elias & V. C. Souza. —A. Habit. —B. Calyx. —C. Corolla dissected longitudinally to reveal androecium. —D. Dorsal stamen. —E. Ventral stamen. —F. Gynoecium. —G. Stigmatic region. —H. Fruit. A–G based on *S. I. Elias & G. S. Rolim 325* (ESA); H based on *J. N. Nakajima* et al. *808* (ESA).

mante road, 18 Mar. 1995, *J. N. Nakajima, R. Romero, R. Cesar & E. Zanini 856* (ESA); Parque Nacional da Serra da Canastra, road to Sacramento, 3 km from administrative headquarters, 17 Mar. 1995, *J. N. Nakajima, R. Romero, R. Cesar & E. Zanini 1958* (ESA); Parque Nacional da Serra da Canastra, 15 Mar. 1990, *H. C. de Sousa s.n.* (BHCB 17976, 17942); Serra da Canastra, 20 Mar. 1990, *H. C. de Souza 175903* (MBM).

Agalinis schwackeana (Diels) V. C. Souza & A. M. Giulietti, comb. nov. Basionym: *Gerardia schwackeana* Diels, Bot. Jahrb. Syst. 25. Beibl. IX: 51. 1898. TYPE: Brazil. Minas Gerais: Serra do Cipó, *Schwacke 7939* (B destroyed); Brazil. Minas Gerais: Serra do Cipó, *L. Damazio–RB 69889* (neotype, designated here, RB).

When the *Montreal Code* (Lanjouw et al., 1961) fixed the typification of the name *Gerardia* L. as applying to plants in the Acanthaceae, it became necessary to create new combinations for the species of Scrophulariaceae described in *Gerardia*. D'Arcy (1978) thus made 16 new transfers for the genus, but some species were left out, including *G. schwackeana*. We rectify this omission and propose the new combination *A. schwackeana* herein.

Since the type of *Gerardia schwackeana* Diels (*Schwacke 7939*) was destroyed at Berlin and no duplicates of this were found, we choose a neotype for this name. Stafleu and Cowan (1981) pointed out that "Schwacke made several of his collections available to Glaziou who sometimes labeled them

as having been collected by himself." So, *Glaziou 19736* (available at BM, BR, G, K, P, and R) could be a good choice, but this is a mixed collection with some specimens of *Agalinis angustifolia*, and some misinterpretation is possible. Thus, *Damazio (RB 69889)*, from the same locality as the type collection, was chosen.

Agalinis schwackeana has sometimes been confused with *A. angustifolia*, but the species differ in the length of leaves (0.5–1.5 cm vs. 2.2–3.4 cm), corolla tube (ca. 1.3 cm vs. 2.3–3.2 cm), pedicel (1–1.8 cm vs. 1–2.8 cm), and calyx tube (3–4 mm vs. 4–7 mm). In addition, stamens are included in *A. schwackeana* but are exserted or reach the corolla mouth in *A. angustifolia*.

Agalinis schwackeana most closely resembles *A. ramulifera* Barringer, a species that occurs in open areas from Minas Gerais, São Paulo, and Espírito Santo. It differs from the latter species by having longer pedicels (1–1.8 cm vs. 0.4–0.7 cm long). Stamens are included in *A. schwackeana* but reach the corolla mouth in *A. ramulifera*. Leaves remain glabrous in *A. schwackeana* but may be strigose above in *A. ramulifera*.

Despite intensive fieldwork in the Serra do Cipó and in the *campos rupestres* of Minas Gerais, there are few collections of *A. schwackeana* and the materials available in the herbarium are old (end of the 19th and beginning of the 20th centuries). Because of that, it has been considered a rare species; however, this species was recently relocated (in 1998) in its original region of occurrence. This species occurs in dry meadows of Minas Gerais between Serra do Cipó and Ouro Preto.

Acknowledgments. We thank the curators of BHCB, HB, HUFU, MBM, and SPF for loans of herbarium materials. Our gratitude is also extended to Wagner de Lima Moreira, Jimi Nakajima, Glauco de Souza Rolim, Juliana de Paula Souza, Wellington Forster, and Lindolpho Capellari, Jr., for their assistance in the field. We also thank FAPESP, CAPES, CNPq, and the British Council for financial support.

Literature Cited

Barroso, G. M. 1952. Scrophulariaceae indígenas e exóticas do Brasil. Rodriguesia. 15(27): 9–64.

Bentham, G. 1846. Scrophulariaceae. *In*: A. De Candolle (editor), Prodromus Systematis Universales Regni Vegetabilis 10: 186–588.

Canne-Hilliker, J. M. 1988. *Agalinis* (Scrophulariaceae) in Peru and Bolivia. Brittonia 40: 433–440.

D'Arcy, W. G. 1978. Names in *Agalinis* for some plants that were called *Gerardia* and *Virgularia* (Scrophulariaceae). Ann. Missouri Bot. Gard. 65: 769–771.

Ichaso, C. L. F. & Barroso, G. M. 1970. Escrofulariáceas. *In*: R. Reitz (editor), Flora Ilustrada Catarinense ESCR: 1–114.

Judd, W. S., C. S. Campbell, E. A. Kellogg & P. F. Stevens. 1999. Plant Systematics: A Phylogenetic Approach. Sinauer, Sunderland, Massachusetts.

Lanjouw, J., Ch. Baehni, W. Robyns, R. Ross, J. Rousseau, J. M. Schopf, G. M. Schulze, A. C. Smith, R. De Vilmorin & F. A. Stafleu. 1961. International Code of Botanical Nomenclature. Regnum Veg. 23.

Schmidt, J. A. 1862. Scrophularinae. *In*: C. F. P. von Martius, A. G. Eichler, I. Urban (editors), Flora Brasiliensis 8(1): 230–339.

Souza, V. C. 1996. Levantamento das Espécies de Scrophulariaceae Nativas do Brasil. Ph.D. Thesis, Instituto de Biociências, Universidade de São Paulo.

Stafleu, F. A. & R. S. Cowan. 1981. Taxonomic Literature, 2nd ed. Scheltema & Holkema, Utrecht.

Wettstein, R. von. 1891. Scrophulariaceae. *In*: A. Engler & K. Prantl (editors), Die natürlichen Pflanzenfamilien. 4(3b): 49–107.

Rubiacearum Americanarum Magna Hama V. *Amphidasya* in Mesoamerica and Western South America

Charlotte M. Taylor
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.
charlotte.taylor@mobot.org

John L. Clark
Department of Systematic Biology - Botany, Smithsonian Institution,
Washington, D.C. 20560-0166, U.S.A., and
George Washington University, Biological Sciences, 2023 G Street, N.W.,
Washington, D.C. 20052, U.S.A. Clark.John@NMNH.SI.EDU

ABSTRACT. The neotropical genus *Amphidasya* includes 13 species in northern South America and adjacent Central America. A key to all the species of this genus is presented; the new combination *Amphidasya longicalycina* (Dwyer) C. M. Taylor is made, based on *Hoffmannia longicalycina* Dwyer, for the most commonly collected species in Central America; and the following new species are described and illustrated: *A. amethystina* J. L. Clark & C. M. Taylor from western Ecuador, *A. brevidentata* C. M. Taylor from western Colombia, *A. elegans* C. M. Taylor from southwestern Colombia and central Ecuador, and *A. panamensis* C. M. Taylor from Panama.

Key words: *Amphidasya*, Central America, Isertieae, Rubiaceae, South America.

The neotropical genus *Amphidasya* Standley comprises about 13 species, and has been relatively little studied. Its greatest species diversity is in Panama and northwestern South America, and thus a review of *Amphidasya* in this region is necessary for preparation of the *Flora Mesoamericana*. This genus has long been classified in the tribe Isertieae of the subfamily Cinchonoideae (Robbrecht, 1988, 1993), but species of *Amphidasya* have raphides while other genera of Isertieae lack these (Robbrecht, 1988). Recent phylogenetic studies of Rubiaceae based on molecular data (Bremer & Thulin, 1998; Rova, 1999; Rova et al., 1999) suggest that this genus is better placed in the subfamily Rubioideae and may be related to *Pauridiantha* Hooker f. Clearly the infrafamilial classification of *Amphidasya* needs reconsideration, but this is beyond the scope of the present work.

Amphidasya is distinguished by its combination of interpetiolar stipules, terminal or pseudoaxillary cymose inflorescences, apparently homostylous flowers, well-developed calyx lobes, valvate corolla aestivation, incompletely to completely bilocular ovaries with numerous ovules on axile placentas, fleshy usually turbinate fruits that are apparently green and perhaps rather dry at maturity, and numerous relatively small, angled, foveolate seeds. All of the species of *Amphidasya* except *A. venezuelensis* (Standley) Steyermark are additionally distinguished by laciniate stipules and a relatively low, usually unbranched suffrutescent habit, and all of these except *A. amethystina* J. L. Clark & C. M. Taylor (described below) and *A. venezuelensis* have anthers with the connective prolonged into an apical appendage. Most of the species have white corollas, and the flowers of at least some species may be nocturnal and functional for only one night (B. Hammel, pers. comm.; Taylor, 1991). The mode of fruit dehiscence (if any) and seed dispersal are unknown.

The first two species of *Amphidasya* described were classified in *Sabicea* Aublet, though they were considered morphologically unusual within that genus (Wernham, 1914; Standley, 1930). Standley subsequently (1936) named the genus *Amphidasya* for these and several additional species with laciniate stipules and a low unbranched habit, and designated *A. ambigua* (Standley) Standley as its type. Steyermark later (1972) reviewed and expanded *Amphidasya*, by describing several new species and also by including species that had been previously described in both *Deppea* Chamisso & Schlechtendal (*D. colombiana* Standley and *D. venezuelensis* Standley) and *Pittierothamnus* Steyermark (*P. elineolatus* Steyermark). The inclusion of *A. venezuelensis* expanded *Amphidasya* to include also plants with a branched shrub habit and entire stipules.

Amphidasya venezuelensis has the reproductive features that distinguish *Amphidasya*, including the relatively well developed calyx lobes, so it seems well placed here. However, this species differs from other *Amphidasya* species in its calyx lobes that do not enlarge markedly in fruit, and from all except *A. amethystina* in its relatively short, tubular, smooth corollas and unappendaged anthers. These three morphological features are found in most other genera of Rubiaceae, including *Pauridiantha* (Verdcourt, 1976), so the unusual features found in many *Amphidasya* species are more likely derived, in particular the low unbranched habit, the laciniate stipules, and the floral features noted below. Since Steyermark's review of the genus, *Amphidasya* has been treated only floristically, by Steyermark (1974), Dwyer (1980), Burger and Taylor (1993), and Andersson (1999).

Several species of *Amphidasya* show morphological features that are unusual in the Rubiaceae. As noted by Steyermark (1972) and well described and illustrated by Andersson (1999: fig. 33), the corollas of several species have multicellular, tuberculate to rather filamentous projections on the margins of their lobes and sometimes also covering their adaxial ("internal") faces; the function of these structures is unknown. The corollas of most species of *Amphidasya* are salverform with relatively long slender tubes about 2–4.5 cm long (Andersson, 1999: fig. 33); only *A. venezuelensis* and *A. amethystina* have corollas with tubes less than 1 cm long. As also noted by Steyermark (1972) and Andersson (1999: fig. 33), the anthers of several species of *Amphidasya* have a linear apical prolongation of the connective, which may be as much as 1 mm long; the function of this structure is also unknown.

Species of *Amphidasya* have five corolla lobes and five elliptic to oblanceolate calyx lobes, except *A. spathulata* Dwyer, where the calyx and corolla each have four lobes and the calyx lobes are composed of a green ovate lamina borne on a stipitate basal portion that lacks blade-like tissue. In most species of *Amphidasya*, the calyx lobes persist and enlarge slightly to markedly as the fruits develop. The fruiting calyx lobes of most *Amphidasya* species in northwestern South America and Central America are approximately equal in size and shape and therefore are not very informative for distinguishing species, but the size of the flowering calyx lobes differs markedly among many of the species. Thus, the measurements used in the key below apply only to the calyx lobes at anthesis.

The taxonomic notes below supplement the treatment that will be presented in the *Flora Mesoamericana*, and several new South American species are described based on recent collections. A key to all the species of *Amphidasya* is included to help distinguish the newly described taxa. The work reported here is based exclusively on study of dried specimens; very little is known about the reproductive biology or morphological variability of these relatively infrequently collected plants, and detailed field studies of *Amphidasya* would be valuable.

Key to *Amphidasya* Species

1a. Stipules entire; erect branched shrubs . . . . . *A. venezuelensis* (Standley) Steyermark
1b. Stipules laciniate; herbs or low, sparsely branched or usually unbranched shrubs.
  2a. Calyx lobes 4, stipitate, with an ovate to lanceolate limb . . . . . *A. spathulata* Dwyer
  2b. Calyx lobes 5, narrowly triangular to triangular, narrowly elliptic, oblanceolate, ligulate, or obovate, not stipitate.
    3a. Leaves oblanceolate to obovate, widest above the middle, at base acute to usually long-attenuate along the petiole.
      4a. Calyx lobes at anthesis 15–24 mm long, linear to narrowly oblanceolate, acute to acuminate; stipules with the undivided basal portion (i.e., the stipule body below the lobes) 2–15 mm long . . . . . *A. ambigua* (Standley) Standley
      4b. Calyx lobes at anthesis 6–15 mm long, narrowly triangular to narrowly oblanceolate, narrowly ligulate, obovate or spatulate; stipules with the undivided basal portion (i.e., the stipule body below the lobes) 1–4 mm long.
        5a. Inflorescences subsessile; calyx lobes acute to acuminate . . . . . *A. longicalycina* (Dwyer) C. M. Taylor, comb. nov.
        5b. Inflorescences with peduncles 0.5–2 cm long; calyx lobes acute to obtuse, rounded, or truncate.
          6a. Stipule lobes 5–13 mm long, western Colombia to Amazonian Peru . . . . . *A. colombiana* (Standley) Steyermark
          6b. Stipule lobes 4–5.5 mm long; Sierra de la Neblina, Venezuela . . . . . *A. neblinae* Steyermark
    3b. Leaves elliptic to elliptic-oblanceolate, narrowly elliptic, elliptic-oblong, or ovate, widest below, at, or just above the middle, at base truncate to obtuse, rounded, cuneate, or acute but not or only shortly attenuate along the petiole.

7a. Corolla tube ca. 8 mm long; stipules with the undivided basal portion (i.e., the stipule body below the lobes) 0.5–2 mm long and lobes 1 to 3 . . . . . *A. amethystina* J. L. Clark & C. M. Taylor, sp. nov.

7b. Corolla tube 11–42 mm long (but unknown in *A. brevidentata*); stipules with the undivided basal portion 1–15 mm long and lobes 4 to 11.

8a. Stipules with the undivided basal portion about 2 or more times as long as the lobes . . . . . *A. brevidentata* C. M. Taylor, sp. nov.

8b. Stipules with the undivided basal portion about half as long as the lobes or shorter than this.

9a. Corolla tube 11–15 mm long; calyx lobes at anthesis oblanceolate, obovate, or spatulate, 0.8–4 mm wide.

10a. Leaves with secondary veins 10 to 15 pairs; corolla tube 13–15 mm long . . . . . *A. colombiana* (Standley) Steyermark

10b. Leaves with secondary veins 16 to 18 pairs; corolla tube 11–11.5 mm long . . . . . *A. intermedia* Steyermark

9b. Corolla tube 25–42 mm long; calyx lobes at anthesis linear to narrowly elliptic, narrowly ligulate, narrowly triangular, or oblanceolate, 0.5–1.5 mm wide.

11a. Calyx lobes at anthesis 9–10 mm long; corolla smooth on the adaxial surfaces of the lobes and the margins . . . . . *A. umbrosa* (Wernham) Standley

11b. Calyx lobes at anthesis 9–19 mm long; corolla markedly verrucose on the adaxial surfaces of the lobes and the margins, sometimes to the point of appearing laciniate.

12a. Corolla tube 36–40 mm long; eastern to central Panama . . . . . *A. panamensis* C. M. Taylor, sp. nov.

12b. Corolla tube 25–30 mm long; northwestern South America.

13a. Corollas in bud acute to acuminate at apex; leaves with secondary veins 10 to 16 pairs . . . . . *A. bullata* Standley

13b. Corollas in bud truncate at apex; leaves with secondary veins 22 to 30 pairs . . . . . *A. elegans* C. M. Taylor, sp. nov.

Amphidasya amethystina J. L. Clark & C. M. Taylor, sp. nov. TYPE: Ecuador. Esmeraldas: cantón Quinindé, Bilsa Biological Station, Mache Mountains, 35 km W of Quinindé, 5 km W of Santa Isabel, 00°21′N, 79°44′W, 400–600 m, 27 Oct. 1995, *J. L. Clark, L. Kvist, P. Mendosa & L. Skog 1514* (holotype, QCNE; isotypes, MO, US). Figure 1.

Haec species a congeneris stipulis in segmenta duo triave tantum divisis, foliis abaxialiter iridescenter azureis purpureisve atque corollae infundibuliformis tubo ca. 8 mm longo distinguitur.

Herbs, rather succulent; stems glabrous. *Leaves* elliptic to ovate, 6–17 × 2.5–10 cm, at apex acute to shortly acuminate, at base obtuse to rounded and often shortly attenuate along petiole, drying membranaceous, adaxially dark green and glabrous, abaxially shiny blue to purple, puberulous to strigillose or hirtellous on veins and glabrous on lamina, often finely crisped on margins; secondary veins 6 to 11 pairs, loosely looping to interconnect near margins; *petioles* 5–40 mm long, glabrous; *stipules* caducous, abaxially puberulous to glabrescent, adaxially glabrous except usually with glandular trichomes to 1.5 mm long, undivided basal portion 0.5–2 mm long, lobes 1 to 3, linear, 5–16 mm long. *Inflorescences* terminal and usually quickly displaced to pseudoaxillary, subsessile or with peduncles to 4 mm long, hirtellous, subcapitate, often deflexed, 1–3 cm diam.; bracts narrowly triangular, 8–13 mm long, acute; *flowers* subsessile; hypanthium turbinate, ca. 2 mm long, puberulous; *calyx* limb sparsely puberulous to glabrous, divided nearly to base, lobes 5, at anthesis narrowly triangular, 9–12 mm long, acute; *corolla* in bud rounded to acute at apex, at anthesis funnelform, white or sometimes tinged blue on lobes, externally and internally glabrous or perhaps sparsely hirtellous in throat, tube ca. 8 mm long, ca. 1 mm diam. at base and ca. 4 mm diam. at throat, lobes 5, deltoid, ca. 2.5 mm long; *anthers* 5, narrowly oblong, ca. 1.5 mm long, positioned near middle of corolla tube, with connective not prolonged; *stigmas* 2, linear, ca. 1.5 mm long, positioned in corolla throat, apparently included. *Fruits* ellipsoid to ovoid, ca. 4 × 3 mm, glabrous, completely bilocular, with persistent calyx lobes similar to those of flowers; *seeds* numerous, 0.3–0.5 mm diam., angled, foveolate.

Habitat, distribution, and phenology. In wet forests at 250–600 m, in the Mache Mountains of coastal western Ecuador; collected in flower in July, September, and October, in fruit in May. This species is most commonly found in small gaps in mature forests. In some such areas, such as the annually cleared 3–5 m wide property boundary of the Bilsa Biological Station in western Ecuador

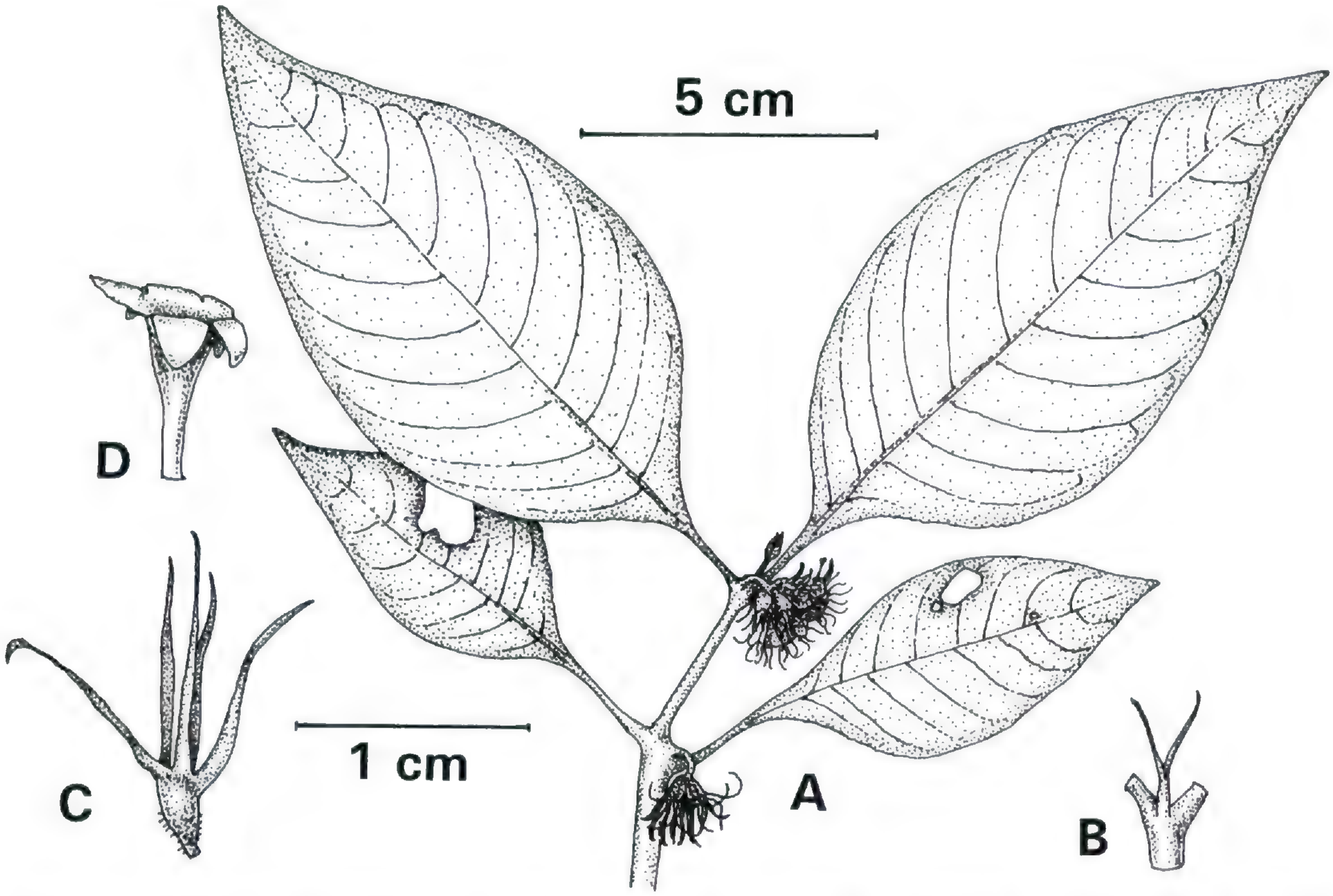


Figure 1. *Amphidasya amethystina* J. L. Clark & C. M. Taylor. —A. Stem with young infructescences. —B. Node with stipule. —C. Calyx (including hypanthium) at anthesis. —D. Corolla at anthesis. A to 5-cm scale; B, C, D to 1-cm scale. A based on *Clark et al. 2864*; B, C, D based on *Clark et al. 1514*.

(Braker, 1998; Clark, 1997), *Amphidasya amethystina* is a common herb forming colonies of three to five individuals. In mature forest *A. amethystina* is usually found in wet or muddy sites, where it forms small populations of dispersed individuals.

Amphidasya amethystina is distinguished by its stipules with only 1 to 3 lobes, its leaves with shiny blue to purple lower (i.e., abaxial) surfaces, and its funnelform corollas with the tubes ca. 8 mm long. This new species is placed in *Amphidasya* based on its laciniate stipules, terminal and pseudoaxillary inflorescences, well-developed calyx lobes, and fruits with numerous, rather small, angled, foveolate seeds. Its corollas resemble those of some species of *Coccocypselum* P. Browne in form and color; that genus also has raphides but differs from *Amphidasya* in its creeping habit, narrowly triangular entire stipules, and relatively reduced calyx lobes. The specific epithet refers to the distinctive color of the undersides of the leaves.

Paratypes. ECUADOR. **Esmeraldas:** cantón Quinindé, Mache-Chindul Ecological Reserve, Bilsa Biological Station, Mache Mountains, 35 km W of Quinindé, 5 km W of Santa Isabel, 00°21′N, 79°44′W, *Clark et al. 124* (MO, QCNE, US), *2568* (GB, MO, NY, QCNE), *2864* (MO, QCNE), *Clark & Pallis 5553* (GB, QCNE), *Pitman et al. 692* (MO, QCNE, US), *Mendosa et al. 576* (AAU, QCA, QCNE, US). **Manabí:** cantón Pedernales, Mache-Chindul Ecological Reserve, comunidad Ambache, via marginal de la costa-Chindul, 00°15′N, 79°48′W, *Clark et al. 4198* (MO, QCNE).

Amphidasya brevidentata C. M. Taylor, sp. nov. TYPE: Colombia. Chocó: municipio San José del Palmar, vereda de Río Negro, Cerro del Torrá, abajo del helipuerto en un antiguo alud, 4°46′N, 76°29′W, 1700 m, 25 Aug. 1988, *J. E. Ramos, P. A. Silverstone[-Sopkin], L. H. Ramos et al. 1493* (holotype, MO-4643634; isotype, CUVC). Figure 2G.

Haec species a congeneris stipulis laciniatis in segmenta longitudinis totae tertiam partem non excedentia divisis distinguitur.

Little-branched soft shrubs to 0.6 m tall; stems sparsely puberulous to glabrous. *Leaves* narrowly elliptic, 23–25 × 5.5–6 cm, at apex acute to somewhat acuminate, at base cuneate to acute, papyraceous, glabrous; secondary veins 20 to 21 pairs, looping to interconnect near margins; *petioles* 7–8 cm long, glabrous; *stipules* abaxially glabrous, adaxially pilose, undivided basal portion 11–15 mm long, triangular to oblong, lobes 4 to 6, narrowly triangular, 3–8 mm long, acute. *Inflorescences* not

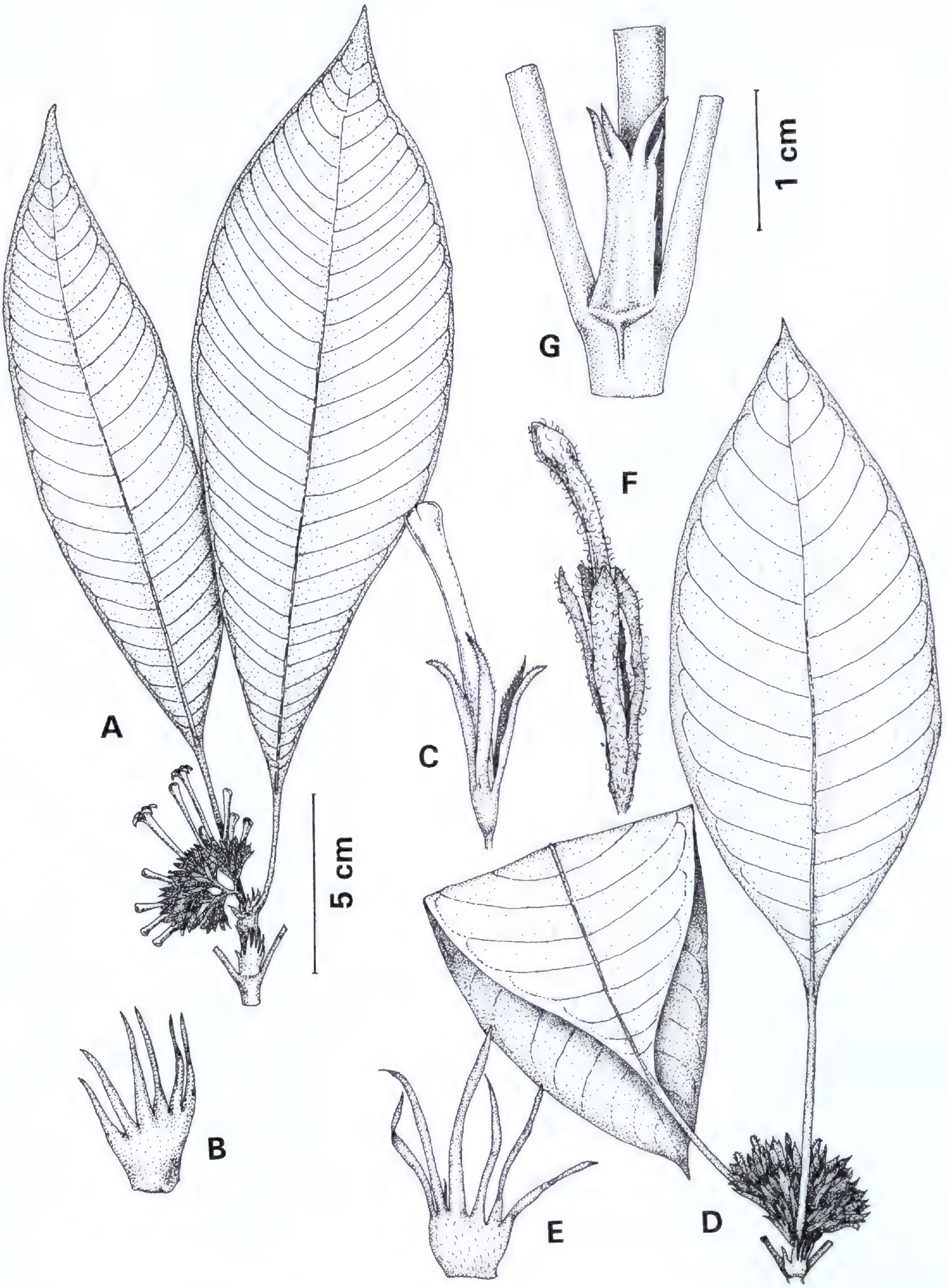


Figure 2. A–C, *Amphidasya elegans* C. M. Taylor. —A. Flowering stem. —B. Stipule. —C. Mature flower bud. D–F, *Amphidasya panamensis* C. M. Taylor. —D. Flowering stem. —E. Stipule. —F. Mature flower bud. —G. Stipule of *Amphidasya brevidentata* C. M. Taylor. A–C based on *Gentry et al. 63606*; D based on *Knapp 1205*; E, F based on *Sytsma et al. 2719*; G based on *Ramos et al. 1493*. A, D to 5-cm scale; B, C, E, F, G to 1-cm scale.

seen. *Infructescences* pseudoaxillary, cymose, pyramidal, glabrous, peduncle ca. 2.5 cm long, branched portion ca. 2 × 2 cm excluding fruits; bracts 4–8 mm long, narrowly lanceolate, entire to laciniate; pedicels 0.5–2 mm long; *fruits* narrowly turbinate to cylindrical, 8–9 × 4.5–5 mm, glabrous, green, with persistent calyx lobes 5, narrowly oblanceolate to usually narrowly ligulate, 6–13 × 0.5–1 mm, acute; seeds numerous, ca. 0.5 mm long, angled, foveolate.

Distribution, habitat, and phenology. In wet forest at ca. 1700 m in the Cerro del Torrá, part of the Cordillera de San Miguel, which is located west of the central Western Cordillera of the Andes in Colombia; collected in fruit in August.

This new species is distinguished from other *Amphidasya* species by its laciniate stipules with the lobes shorter than the undivided basal portion. It is known only from the type specimen, which was collected in a poorly known region of Colombia (Silverstone-Sopkin & Ramos-Pérez, 1995), and its flowers have not been seen. The specific epithet refers to the relatively short stipule lobes.

Amphidasya elegans C. M. Taylor, sp. nov. TYPE: Colombia. Nariño: trail from La Planada to Pielapi, 1600–1800 m, 1°04′N, 78°02′W, 22 July 1988, *A. Gentry, O. de Benavides, C. Samper, P. Velásquez & B. Ramírez 63606* (holotype, MO-4976644; isotype, MO-4641169). Figure 2A–C.

Haec species a congeneris foliorum venis secundariis 22- ad 30-jugatis, lobulis calycinis sub anthesi 0.5–1.5 mm latis atque corolla in alabastro apice truncata sub anthesi tubo 25–30 mm longo ac lobulis ca. 4 mm longis distinguitur.

Suffrutescent plants to 0.6 m tall; stems moderately hirtellous to glabrescent. *Leaves* elliptic to elliptic-oblong, 17–24 × 4.5–10 cm, at apex acute to acuminate, at base obtuse to cuneate, papyraceous, adaxially glabrous, abaxially hirtellous to usually strigillose on veins and glabrous on lamina; secondary veins 22 to 30 pairs, looping to interconnect near margins; *petioles* 3.5–7 cm long, hirtellous to glabrescent; *stipules* abaxially sparsely hirtellous to glabrescent, adaxially glabrous or pilose near base, the undivided basal portion 4–6 mm long, lobes 6 to 8, narrowly triangular, 4–14 mm long, acute. *Inflorescences* terminal and pseudoaxillary, subsessile or with peduncles to 8 mm long, hirtellous to strigillose, branched portion corymbiform, 2–2.5 × 2–3 cm excluding corollas, bracts 2–4 mm long, linear to narrowly triangular; pedicels 0.5–3 mm long; *flowers* subsessile to pedicellate in cymules of 3; hypanthium hirtellous, 3–4 mm long, turbinate; *calyx limb* hirtellous to glabrescent, lobed nearly to base, lobes 5, at anthesis narrowly triangular to narrowly oblanceolate, 9–12 × 0.5–1.5 mm, acute, often rather falcate; corolla in bud truncate at apex, at anthesis slenderly salverform, externally moderately to sparsely hirtellous, internally glabrous, tube 25–30 mm long, 1–1.5 mm diam., lobes 5, deltoid, ca. 4 mm long, adaxially densely verrucose on surfaces and margins (sometimes appearing laciniate); *anthers* 5, included in the corolla throat, ca. 1.8 mm long, with apical prolongation of connective ca. 1 mm long, linear, glabrous; *stigmas* 2, narrowly ellipsoid to linear, ca. 2 mm long, apparently included in the corolla throat. *Fruits* not seen.

Distribution, habitat, and phenology. In wet premontane and lower montane forests at 1500–1800 m, southwestern Colombia to central Ecuador; collected in flower in March and July.

This new species is distinguished by its combination of leaves with the secondary veins 22 to 30 pairs, calyx lobes at anthesis 0.5–1.5 mm wide, and corollas truncate at the apex in bud and with tubes 25–30 mm long and lobes ca. 4 mm long at anthesis. The shape of the corollas in bud clearly distinguishes this from other species of *Amphidasya*. The elevational zone inhabited by this species appears to be one of the most floristically diverse yet least explored parts of the northern Andean region. The specific epithet refers to the attractive general aspect of this plant.

Paratypes. ECUADOR. **Napo:** cantón Archidona, Parque Nacional Napo-Galeras, Cordillera de Galeras, sendero hacia Huamaní, 00°39′S, 77°31′W, *A. Alvarez et al. 1585* (MO, QCNE).

Amphidaysa longicalycina (Dwyer) C. M. Taylor, comb. nov. Basionym: *Hoffmannia longicalycina* Dwyer, Ann. Missouri Bot. Gard. 56: 280. 1980. TYPE: Panama. Darién: Cuasi-Cana Trail between Cerro Campamiento and La Escalera to "Paramo," E of Tres Bocas, 30 Apr. 1968, *J. H. Kirkbride, Jr. & J. Duke 1278* (holotype, MO-2165098).

Herbs, sometimes suffrutescent, to 0.5 m tall; stems puberulous to glabrescent. *Leaves* oblanceolate to elliptic-oblanceolate, 12–31 × 4–12 cm, at apex acute to acuminate, at base acute to attenuate, membranaceous, adaxially glabrous, abaxially pilosulous to usually puberulous on principal veins and glabrescent on lamina; secondary veins 12 to 25 pairs, weakly looping to interconnect near margins; *petioles* 1.5–7 cm long, densely puberulous to

strigillose; *stipules* puberulous to strigose, undivided basal portion 1–4 mm long, lobes 5 to 10, linear, 10–22 mm long. *Inflorescences* terminal but rapidly displaced to pseudoaxillary, congested cymose, subsessile; bracts narrowly triangular, ca. 5 mm long; *flowers* subsessile in glomerules or cymules of 3; hypanthium ellipsoid to cylindrical, ca. 3 mm long, puberulous; *calyx* limb puberulous, lobed nearly to base, lobes 5, at anthesis narrowly triangular to narrowly ligulate, 6–13 × 1–2.5 mm, acute to acuminate; *corolla* in bud rounded to acute at apex, at anthesis slenderly salverform, externally hirtellous, internally glabrous except sparsely to moderately pilose in throat and on bases of lobes, tube 30–40 mm long, ca. 2 mm diam., lobes 5, narrowly elliptic, 8–15 mm long, acute to acuminate, adaxially verrucose; *anthers* 5, included in corolla throat, ca. 2 mm long, with apical prolongation of connective ca. 1.2 mm long; *stigmas* 2, included in corolla throat and apparently positioned below anthers, linear, ca. 2 mm long. *Fruits* ellipsoid to cylindrical or turbinate, 8–10 × 4–5 mm, puberulous to glabrescent, with calyx limb deciduous before fruit matures; seeds numerous, ca. 0.5 mm long, angled, foveolate.

Habitat, distribution, and phenology. Wet forests at 60–1400 m, southeastern Nicaragua to northwestern Colombia; collected in flower in January through April and July through November, in fruit throughout the year.

This species has previously been included within a widespread, morphologically variable circumscription of *Amphidasya ambigua* (Standley) Standley (Taylor, 1991; Burger & Taylor, 1993; Taylor, 2001). However, as circumscribed here *A. longicalycina* is found from Nicaragua to northwestern Colombia, while *A. ambigua* is less variable morphologically and restricted to eastern Panama and northwestern South America. *Amphidasya ambigua* is distinguished by its calyx lobes 15–24 mm long at anthesis and its corolla tubes ca. 30 mm long. A detailed description of *A. longicalycina* is presented above because Dwyer's original description of this species was brief and based on rather poor material. The figure of "*A. ambigua*" presented by Dwyer (1980: fig. 5) cannot be conclusively identified as to whether it represents *A. ambigua* or *A. longicalycina*, because its detail is inadequate and the specimen from which it was drawn (*Dressler & Mahler 1244*) has not been relocated.

Dwyer based the name *Hoffmannia longicalycina* on a specimen bearing only mature fruits. Typically for both *Hoffmannia* and *Amphidasya* in this stage of development, its stipules have fallen off so their form is not evident, and the calyx lobes have also fallen off the mounted specimen although Dwyer included a description of these ("to 13 mm long"). Atypically for *Hoffmannia* (Dwyer, 1969: 270) but typically for *Amphidasya*, these calyx lobes are more than 5 mm long and the inflorescences are clearly terminal. Dwyer noted in his original description of *H. longicalycina* that this species seemed to him very similar to *Amphidasya*, but he concluded that the species could not belong to *Amphidasya* because its fruits have a complete septum, and he considered *Amphidasya* to have only incomplete septa. However, Andersson (1999) reported that the septum of *Amphidasya* may be complete or incomplete, so this feature is actually not informative. Dwyer's specimen matches in all its details the most commonly collected but otherwise unnamed Central American species of *Amphidasya*; therefore, this new combination is needed.

There appears to be some clinal variation in the length of the calyx lobes in this species, from shortest in Nicaragua and Costa Rica to longest in eastern Panama, and there may also be some clinal variation in corolla length, but the flowering specimens presently available are not adequately preserved to evaluate this. There also appears to be some variation in calyx lobe length within local populations, though whether this is actual morphological variation or an artifact of specimen preparation is difficult to determine.

Representative collections examined. COLOMBIA. **Chocó:** hills behind Bahía Solano (Puerto Mutis), *Gentry & Forero 7228* (MO). COSTA RICA. **Heredia:** Finca La Selva, the OTS Field Station on the Río Puerto Viejo, just E of its junction with the Río Sarapiquí, along Quebrada El Saltito, *Hammel & Trainer 10843* (DUKE, MO). **Limón:** Cerro Coronel, E of Laguna Danto, 10°41′N, 83°38′W, *Stevens 23818* (MO). **Puntarenas:** along road from Panamerican Highway at Piedras Blancas to Rincón (on Osa Peninsula), 3.7 mi. W of Panamerican Highway, 8°46′N, 83°18′W, *Croat 67642* (MO). NICARAGUA. **Río San Juan:** near Caño Chonataleño 20 km NE of El Castillo, *Neill & Vincelli 3616* (MO). PANAMA. **Bocas del Toro:** above Chiriquí Grande, 10 road-miles from continental divide, ca. 2 road-miles along road E of highway, 8°55′04″N, 82°10′04″W, *McPherson 10469* (MO). **Coclé:** near sawmill 16.7 km N of turnoff to Coclesito from Llano Grande, *Hammel 1852* (MO). **Colón:** trail from end of Santa Rita Ridge Road to Río Piedras, *Antonio 3773* (MO). **Darién:** along ridge N of Ensenada El Guayabao that separates the Río Jaqué Valley from the Pacific Ocean, 7°26′N, 78°05′W, *Knapp & Mallet 3179* (MO). **Panamá:** road from El Llano to Cartí, the deep ditch, 12.4 km N of Panamerican Highway, *Folsom et al. 6183* (MO). **San Blas:** El Llano–Cartí Road, Km 18.3, 9°19′N, 78°55′W, *de Nevers 5988* (MO).

Amphidasya panamensis C. M. Taylor, sp. nov. TYPE: Panama. Panamá: Cerro Jefe, desviación 300 m antes de llegar a la torre, 500 m, 6 May 1987, *I. A. Valdespino, P. Solis & J. Sporle 694* (holotype, PMA; isotype, MO-4297807). Figure 2D–F.

Haec species ab *Amphidasya bullata* corolla extus dense hirtella in alabastro parte ex lobulorum constante ellipsoidea apice acute rotundata obtusave atque lobulis corollinis sub anthesi 6–7 mm longis adaxialiter omnino dense verruculosis distinguitur.

Unbranched herbs, sometimes suffrutescent, to 1.5 m tall; stems hirtellous to glabrescent. *Leaves* elliptic to elliptic-oblong, 15–24 × 5.5–11 cm, at apex acute to usually acuminate or cuspidate, at base cuneate to acute, papyraceous, adaxially glabrous, abaxially hirtellous on principal veins and glabrescent on lamina; secondary veins 13 to 16 pairs, weakly to strongly looping to interconnect; *petioles* 3.5–13.5 cm long, densely hirtellous; *stipules* hirtellous to densely so, undivided basal portion 3–10 mm long, lobes 7, linear, 10–38 mm long. *Inflorescences* terminal and pseudoaxillary, subcapitate, subsessile, hirtellous; bracts triangular, 4–5 mm long; *flowers* subsessile in glomerules or cymules of 3; hypanthium turbinate, ca. 2 mm long, densely hirtellous to strigillose; *calyx* limb densely hirtellous to pilosulous, lobed nearly to base, lobes 5, at anthesis narrowly triangular to narrowly ligulate, 12–19 × 1–1.5 mm, acute to a little acuminate; *corolla* in bud acute to obtuse or rounded at apex, at anthesis slenderly salverform, externally densely hirtellous, internally glabrous except sparsely pilose at stamen insertion, tube 36–40 mm long, ca. 1 mm diam., lobes 5, triangular, 6–7 mm long, acute, adaxially densely verrucose on surfaces and margins (sometimes appearing laciniate); *anthers* 5, included in corolla throat, ca. 1.5 mm long, with apical prolongation of connective ca. 1 mm long; immature *stigmas* 2, narrowly elliptic to linear, included in corolla throat, apparently positioned just below anthers, ca. 1 mm long. *Fruits* ellipsoid to cylindrical or turbinate, 8–10 × 4–5 mm, hirtellous, with persistent calyx lobes to 18 mm long; seeds numerous, ca. 0.5 mm long, angled, foveolate.

Distribution, habitat, and phenology. In wet forests at 350–1000 m, eastern to central Panama; collected in flower in May, August, November, and December, in fruit in January, February, May, July, and September.

This new species is distinguished by its elliptic to elliptic-oblong leaves, its corollas that are acute to rounded or obtuse at the apex in bud, its corolla tubes that are densely hirtellous externally, and its corolla lobes 6–7 mm long at anthesis and densely verruculose on their entire adaxial ("internal") surfaces. It is similar to *Amphidasya bullata* Standley of western Colombia; *A. bullata* differs in its corollas that are acute to acuminate at the apex in bud, its corolla tubes that are sparsely hirtellous externally, and its corolla lobes that are longer, 10–16 mm long at anthesis, and verrucose only along their margins. The species epithet refers to its geographic distribution.

Paratypes. PANAMA. **Colón:** trail from Alto Pacora to Cerro Brewster, 9°18′N, 79°16′W, *G. de Nevers et al. 6259* (MO). **Darién:** Cerro Pirre, *Duke & Elias 13660* (MO); Cerro Sapo, *Hammel 1242* (MO). **Panamá:** Campo Tres, 5 km NE of Altos de Pacora, *Busey 828* (MO); Cerro Jefe to La Eneida, *Dressler 3571* (MO); headwaters of the Rio Utiva, Cerro Jefe, 2 km from last branch in road to summit, 9°15′N, 79°30′W, *Knapp 1205* (MO); E slope of Cerro Jefe, dirt track near radio tower, 9°15′N, 79°30′W, *Knapp & Mallet 5188* (MO); La Eneida, Cerro Jefe region, *Maas & Dressler 682* (MO); Cerro Jefe region, along old road about 0.5 mi. below summit tower, 9°15′N, 79°30′W, *McPherson 12736* (MO). **San Blas:** Cerro Obu, *de Nevers et al. 8065* (MO); Cerro Habú, vicinity of peak, 9°23′N, 78°49′W, *Sytsma et al. 2719* (MO), *2742* (MO); El Llano–Cartí road, 12 mi. from PanAmerican Highway, *Sytsma & Andersson 4507* (MO).

Acknowledgments. We thank M. Correa of PMA and SCZ for specimens and information; DUKE and F for loans of specimens; R. E. Gereau for preparation of the Latin diagnoses; B. Hammel and P. A. Silverstone-Sopkin for helpful reviews of this manuscript; and R. Foster, T. Wachter, and the Andrew Mellon Foundation through a grant to the Field Museum of Natural History for logistical and financial support for CMT's travel related to this project.

Literature Cited

Andersson, L. 1999. *Amphidasya.* Fl. Ecuador 62: 114–119.

Braker, E. (editor). 1998. Field station profile: The Bilsa Biological Station, Ecuador. Tropinet 9(3): 2.

Bremer, B. & M. Thulin. 1998. Collapse of Isertieae, reestablishment of Mussaendeae, and a new genus of Sabiceeae (Rubiaceae): Phylogenetic relationships based on *rbc*L data. Pl. Syst. Evol. 211: 71–92.

Burger, W. & C. M. Taylor. 1993. Flora Costaricensis, Family #202 Rubiaceae. Fieldiana, Bot. n.s. 33: 1–333.

Clark, J. L. 1997. Preliminary floristic inventory of the Bilsa Biological Station, Esmeraldas, Ecuador. Pp. 123–128 *in* R. Valencia & H. Balslev (editors), Estudios sobre Diversidad y Ecología de Plantas. Pontificia Universidad Católica de Ecuador, Quito.

Dwyer, J. D. 1969. The genus *Hoffmannia* (Rubiaceae) in Panama. Ann. Missouri Bot. Gard. 56: 269–286.

———. 1980. Rubiaceae. *In:* R. E. Woodson, Jr., R. W. Schery & Collaborators, Flora of Panama—Part IX. Ann. Missouri Bot. Gard. 67: 1–522.

Robbrecht, E. 1988. Tropical woody Rubiaceae. Opera Bot. Belg. 1: 1–271.

———. 1993. Supplement to the 1988 outline of the classification of the Rubiaceae, Index to genera. Opera Bot. Belg. 6: 173–196.

Rova, J. H. E. 1999. Rubiaceae phylogeny based on *rps*16 sequence data. *In:* The Rondeletieae–Condamineeae–Sipaneeae Complex (Rubiaceae) 2: 1–29. Göteborg University, Sweden.

———, P. G. Delprete, L. Andersson & V. A. Albert. 1999. Rubiaceae phylogeny based on *trn*L-F sequence data. *In:* J. H. E. Rova, The Rondeletieae–Condamineeae–Sipaneeae Complex (Rubiaceae) 1: 1–35. Göteborg University, Sweden.

Silverstone-Sopkin, P. A. & J. E. Ramos-Pérez. 1995. Floristic exploration and phytogeography of the Cerro del Torrá, Chocó, Colombia. Pp. 169–186 *in* S. P. Churchill et al. (editors), Biodiversity and Conservation of Neotropical Montane Forests. New York Botanical Garden, the Bronx.

Standley, P. C. 1930. The Rubiaceae of Colombia. Publ. Field Columbian Mus., Bot. Ser. 7(1): 1–175.

———. 1936. Studies of American Plants—VI. Field Mus. Nat. Hist., Bot. Ser. 11(5): 145–276.

Steyermark, J. A. 1972. *Amphidasya.* Mem. New York Bot. Gard. 23: 316–322.

———. 1974. *Amphidasya. In:* T. Lasser (editor), Flora de Venezuela 9(1): 502–508.

Taylor, C. M. 1991. Rubiaceae. *In:* R. W. Wilbur (editor), The Vascular Flora of the La Selva Field Station. Selbyana 12: 141–190.

———. 2001. Rubiaceae. *In:* W. D. Stevens, C. Ulloa U., A. Pool & O. M. Montiel (editors), Flora de Nicaragua. Monogr. Syst. Bot. Missouri Bot. Gard. 85(3): 2206–2284.

Verdcourt, B. 1976. Rubiaceae (Part 1). *In:* R. M. Polhill (editor), Flora of Tropical East Africa.

Wernham, H. F. 1914. A Monograph of the Genus *Sabicea.* British Museum (Natural History), London.

Aralia frodiniana (Araliaceae), a New Species from Indonesia

Jun Wen

Department of Botany, Field Museum of Natural History, 1400 S. Lake Shore Dr., Chicago, Illinois 60605, U.S.A. jwen@fieldmuseum.org

ABSTRACT. A new species of *Aralia* from Sulawesi, Indonesia, *A. frodiniana* J. Wen, is described and illustrated. The new species belongs to *Aralia* sect. *Dimorphanthus* and is similar to *A. montana* from Java and Sumatra of Indonesia in its short or subsessile petiolules, and the narrowly triangular, dark brownish and glabrous inflorescence bracts with ciliate margins. *Aralia frodiniana* is distinguished from *A. montana* by its densely pubescent inflorescence, more pubescent leaves, and thinner leaflets. It differs from *A. ferox* from Java and Sumatra in its pubescent (vs. glabrescent) leaflets, and densely pubescent (vs. glabrous) inflorescence.

Key words: *Aralia*, Araliaceae, Indonesia.

Aralia L. (Araliaceae) consists of approximately 65 species distributed in eastern to southeastern Asia and in the Americas from Canada to Argentina, Bolivia, and Peru (Wen, 1993, 2001a). Recent systematic studies of *Aralia* (Wen, 1994, 2000a, 2000b, 2001a, 2001b; Wen et al., 1998) have led to the discovery of a new species, *A. frodiniana*, described here from Sulawesi (formerly Celebes), Indonesia. The new species is one of the 27 species of *Aralia* sect. *Dimorphanthus* (Miquel) Miquel, which has a disjunct distribution between eastern to southeastern Asia (25 spp.) and eastern North America (2 spp.). A detailed taxonomic account of section *Dimorphanthus* is provided by Wen (2001b). *Aralia frodiniana* possesses the synapomorphies of section *Dimorphanthus*: woody habit, prickly stems, bipinnate to tripinnate leaves, and relatively large pollen tectoral perforations (Wen, 2001b). This taxon is one of only two species of *Aralia* recorded from Sulawesi, the other being *A. merrillii* Shang (also belonging to sect. *Dimorphanthus*), which was treated in *Flora Malesiana* as *A. scandens* (Merrill) Ha (Philipson, 1979).

Aralia frodiniana J. Wen, sp. nov. TYPE: Indonesia. Sulawesi: "Celebes en Onderhond. afd. Bonthain, Paring talasa," 18 Apr. 1922, *Boschproefstation 5462* (holotype, L). Figure 1.

Frutex erectus, aculeatus. Folia bipinnata; foliolis ovatis, 3–8 cm longis, 2.0–4.5 cm latis, apice acutis vel acuminatis, basi rotundatis vel subcordatis, margine serratis. Inflorescentia terminalis, pubens, ca. 35 cm longa; umbellis 12- ad 35-floris; pedicellis 5–12 mm longis. Fructus globosus, 3.2–4.1 mm longus, 3.0–3.8 mm latus.

Erect shrubs with prickles on stem. Leaves bipinnate, each pinna subtended by a stipel; petioles with a few conically shaped prickles, pubescent; stipules coriaceous, almost entirely fused with each other at the petiole base, ca. 2 cm long; leaflets ovate, occasionally elliptic, 3–8 × 2.0–4.5 cm, acute to acuminate at apex, rounded to occasionally acute or slightly subcordate at base; serrate at margin; coriaceous to thick papery; petiolules 0–1 mm long; adaxial surface dark green, with conspicuous, sunken and somewhat pubescent veins and veinlets; abaxial surface grayish green, densely pubescent; lateral veins 8 or 9; stipels with petiolules 0.8–2.2 cm long. Inflorescence terminal, ca. 35 cm long, densely pubescent, prickles absent, main axis ca. 12 cm long, ca. 15 primary lateral branches forming a large panicle; each 30–35 × 15–20 cm, with many (ca. 40) secondary branches; secondary branches with 3 to 10 umbels; umbels 12- to 35-flowered; pedicels pilose to pubescent, 5–12 mm long; bracts subtending primary branches narrowly triangular, ca. 15 × 5–7 mm, dark brownish, ciliate, glabrous elsewhere; bracteoles lanceolate, 1.7–1.9 × ca. 1 mm, glabrous or only slightly ciliate. Flowers not seen. Fruits globose, 3.2–4.1 × 3.0–3.8 mm, with persistent sepals and styles; styles connate for 3/4 of their length from the base, divided and recurved above, 2–2.2 mm long. Seeds 5 per fruit.

Distribution. Endemic to the island of Sulawesi, Indonesia.

Phenology. Flowers not recorded, fruiting in April to June.

This species is named in honor of my colleague David Frodin, who has provided much encouragement in my studies of Araliaceae.

Aralia frodiniana is similar to *A. montana* Blume (sect. *Dimorphanthus*) from Java and Sumatra (Wen, 2001b) in its short to subsessile petiolules, and its narrowly triangular, dark brownish and glabrous bracts, which may be ciliate along the margin. It is distinguished from *A. montana* by its densely pu-

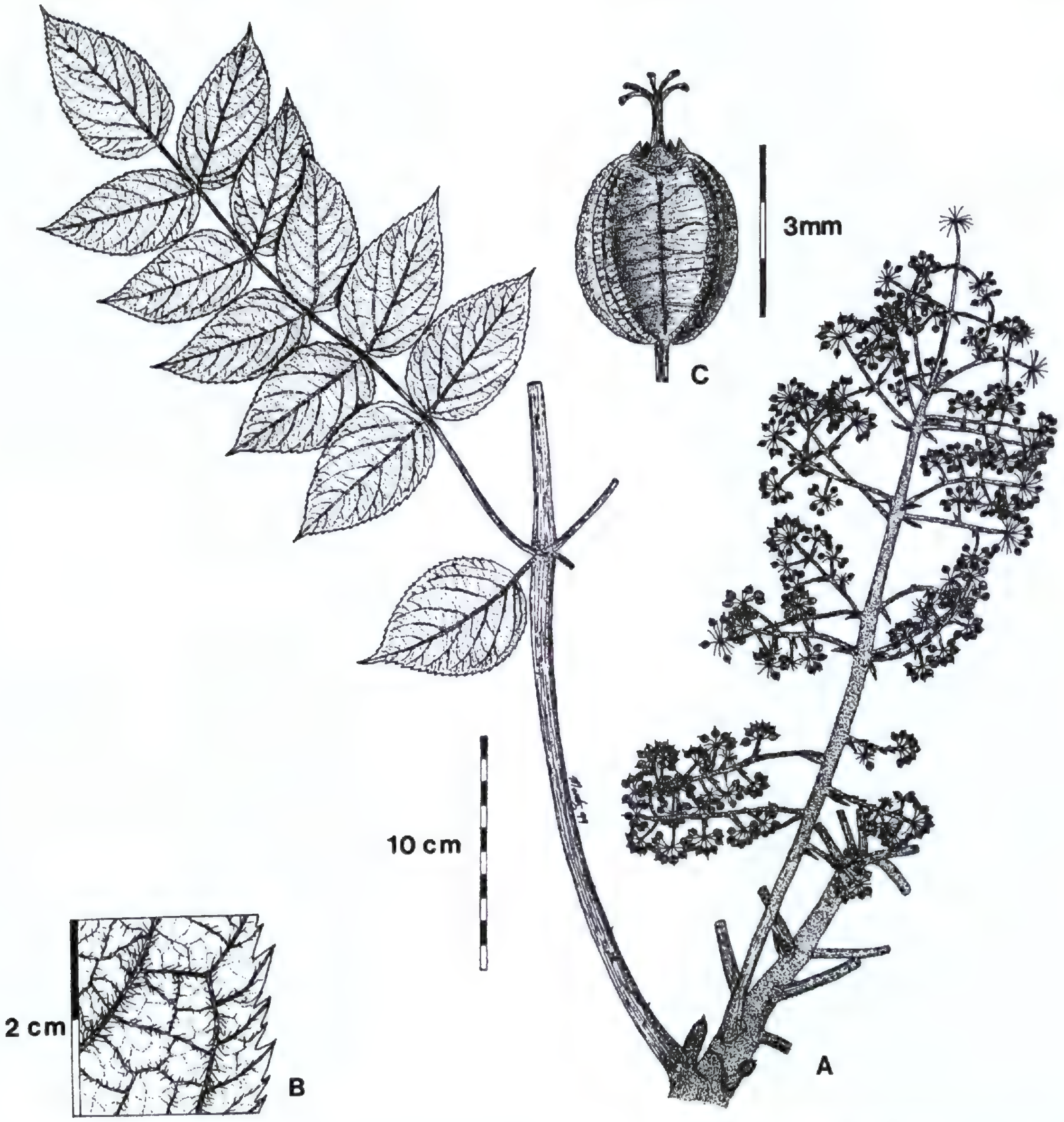


Figure 1. *Aralia frodiniana* J. Wen. —A. Leaf with infructescence. —B. Leaflet abaxial surface. —C. Fruit. A–C drawn from the type, *Boschproefstation 5462*.

bescent inflorescence, more pubescent leaves, and thinner leaflets. *Aralia frodiniana* differs from *A. ferox* Miquel from Java and Sumatra in having somewhat larger leaflets (3.0–8.0 × 2.0–4.5 cm vs. 2.5–6.5 × 1.2–3.5 cm) that are pubescent (vs. glabrescent or with short bristles on veins and veinlets), and a densely pubescent (vs. glabrous) inflorescence. *Aralia merrillii* (the only other *Aralia* species in Sulawesi) is highly distinctive by its scandent or climbing habit, recurved (vs. straight) prickles, mostly glabrous (vs. pubescent) leaflets with long petiolules (3–13 mm), caducous (vs. persistent) bracts, and glabrous (vs. pilose to pubescent) pedicels. For a detailed discussion of taxa in *Aralia* sect. *Dimorphanthus*, see Wen (2001b).

Aralia frodiniana is presently only known from two collections (the holotype and the paratype). The conservational status of the species needs to be investigated.

Paratype. INDONESIA. **Southwest Sulawesi** (Celebes): G. Bonthain, ca. 2600 m, 14 June 1921, *Bunnemeijer 12147* (L).

Acknowledgments. I thank Jeff Martz for preparing the illustration, the curators of L for permitting the examination of their specimens, Murray

Henwood, Pete Lowry, an anonymous reviewer, and editor Victoria Hollowell for helpful advice. Financial support was provided by the National Science Foundation (DEB-0196051).

Literature Cited

Philipson, W. R. 1979. Araliaceae. Pp. 1–105 *in* C. G. G. J. van Steenis (editor), Flora Malesiana, Vol. 9. Martinus Nijhoff, the Hague.

Wen, J. 1993. Generic delimitation of *Aralia* (Araliaceae). Brittonia 45: 47–55.

———. 1994. New taxa and nomenclatural changes in *Aralia* (Araliaceae). Novon 4: 40–43.

———. 2000a. Internal transcribed spacer phylogeny of the eastern Asian and eastern North American disjunct *Aralia* sect. *Dimorphanthus* (Araliaceae) and its biogeographic implications. Int. J. Pl. Sci. 161: 959–966.

———. 2000b. Revision of some woody taxa of *Aralia* L. (Araliaceae). Acta Phytotax. Sin. 38: 1–9.

———. 2001a. Evolution of the *Aralia–Panax* complex (Araliaceae) as inferred from nuclear ribosomal ITS sequences. Edinburgh J. Bot. 58: 183–200.

———. 2001b. Systematics and biogeography of *Aralia* sect. *Dimorphanthus* (Miq.) Miq. (Araliaceae). Fieldiana (In press).

———, S. Shi, R. K. Jansen & E. A. Zimmer. 1998. Phylogeny and biogeography of *Aralia* sect. *Aralia* (Araliaceae). Amer. J. Bot. 85: 866–875.

New Taxa and Combinations in *Ocotea* (Lauraceae) from Central America

Henk van der Werff
Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ABSTRACT. In the course of preparing a treatment of the genus *Ocotea* for the *Flora Mesoamericana* the following novelties were found and are published in this contribution: three new combinations, *Ocotea amplifolia* (Mez & Donnell Smith) van der Werff, *O. parvula* (Lundell) van der Werff, *O. vanderwerffii* (Kostermans) van der Werff; and nine new species, *O. adela* van der Werff, *O. atlantica* van der Werff, *O. darcyi* van der Werff, *O. haberi* van der Werff, *O. jefensis* van der Werff, *O. klepperae* van der Werff, *O. macrantha* van der Werff, *O. oblongifolia* van der Werff, and *O. pullifolia* van der Werff.

Key words: Central America, Lauraceae, *Ocotea*.

Ocotea Aublet is one of the larger genera of the Lauraceae, with an estimated 300 species. Most species occur in the American tropics, but the genus is also present in tropical Africa and Madagascar, with one species present in the Canary Islands. *Ocotea* is represented in Central America by 101 species and is by far the largest genus of Lauraceae in this region. This is a large increase over the number recognized by Carolyn Allen, who wrote a treatment of *Ocotea* in Central America in 1945. She included only 33 species; this low number was certainly influenced by the paucity of collections and the lack of access to the specimens in European herbaria. Since 1980, 37 Central American species of *Ocotea* have been described by various authors and herein, and most of these species were based on recent collections. This includes 2 species that will soon be published by F. Lorea-Hernandez and myself. The distribution of these 37 species is presented in Table 1. Most of these species (25) are found in only 1 country/region (S Mexico consists here of the area from the Isthmus of Tehuantepec southward); 8 species are restricted to southern Mexico, 9 to Costa Rica, 6 to Panama, but only 1 each to Nicaragua and Guatemala and none to Honduras or El Salvador. One might expect a decrease in the number of novelties from well-collected areas as our knowledge becomes more or less complete. The fact that the majority of the new species come from the best-collected areas in Central America and the fact that nearly all recently described species are based on recent collections (the exception is *Ocotea oblongifolia* van der Werff from Guatemala, collected in 1966) strongly indicate that our knowledge of *Ocotea* species in Central America is far from complete and that more new species will come to light. Thirteen recently described species are known from more than 1 country. Nine are restricted to Panama and Costa Rica, 2 occur in Nicaragua and Honduras (+ El Salvador), while 2 species occur in Nicaragua and Costa Rica (see Table 1). Both (*O. atlantica* and *O. dentata* van der Werff) are restricted to lowland forests on the Caribbean slope. These figures suggest that quite a few species do not cross the Costa Rica–Nicaragua boundary. In order to see if this is a general tendency in *Ocotea*, I checked the distribution of all 101 species based on MO holdings and found the following: Known in Central America only from Panama and Costa Rica (some of these species occur also in South America): 42 species; known only from Nicaragua to southern Mexico: 41 species; widespread species, crossing the Nicaragua–Costa Rica boundary: 18 species. This last category includes a number of species with a very large distribution, such as *Ocotea cernua* (Nees) Mez, which ranges from Mexico to Bolivia and southern Brazil. Thus, the distribution of *Ocotea* species in Central America shows a distinct Panama–Costa Rica element and a distinct Nicaragua–southern Mexico one. There are, however, no indications from my survey that species groups (such as the *O. helicterifolia* group, the *O. heydeana* group, the *O. meziana* group, and *Ocotea* subg. *Dendrodaphne* (Beurling) Mez) are confined to either the northern or the southern area, but species of these groups are more or less equally distributed in Central America.

The novelties for this region are the following:

Ocotea adela van der Werff, sp. nov. TYPE: Panama. Panamá: Cerro Jefe, 6 Jan. 1971, *T. Croat 13049* (holotype, MO; isotypes, HBG, PMA). Figure 1.

Ocoteae camphoromoeae affinis, sed indumento erec-

Table 1. Distribution of recently described *Ocotea* species in Central America.

	S. Mexico	Guatemala	Honduras	El Salvador	Nicaragua	Costa Rica	Panama
O. congregata van der Werff	x						
O. corrugata van der Werff	x						
O. heribertoi T. Wendt	x						
O. iridescens Lorea-Hernandez & van der Werff, ined.	x						
O. rovirosae Lorea-Hernandez & van der Werff, ined.	x						
O. uxpanapana T. Wendt & van der Werff	x						
O. vanderwerffii (Kostermans) van der Werff	x						
O. verticillata Rohwer	x						
O. oblongifolia van der Werff		x					
O. strigosa van der Werff					x		
O. rhytidotricha Rohwer			x	x	x		
O. jorge-escobarii C. Nelson			x		x		
O. klepperae van der Werff						x	
O. lentii W. Burger						x	
O. macrantha van der Werff						x	
O. morae Gomez-Laurito						x	
O. monteverdensis W. Burger						x	
O. multiflora van der Werff						x	
O. gomezii W. Burger						x	
O. patula van der Werff						x	
O. rufescens van der Werff						x	
O. adela van der Werff							x
O. arcuata Rohwer							x
O. darcyi van der Werff							x
O. gordonii van der Werff							x
O. jefensis van der Werff							x
O. pausiaca Rohwer							x
O. haberi van der Werff						x	x
O. hartshorniana Hammel						x	x
O. holdridgeiana W. Burger						x	x
O. pharomachrosorum Gomez-Laurito						x	x
O. praetermissa van der Werff						x	x
O. pseudopalmana W. Burger						x	x
O. pullifolia van der Werff						x	x
O. valerioides W. Burger						x	x
O. dentata van der Werff				x		x	x
O. atlantica van der Werff	x			x		x	

tiusculo ramulorum gemmarumque, foliis minoribus recedit.

Dioecious shrub or small tree, to 8 m. Twigs ridged, solid, sparsely to moderately puberulous, the hairs very short (ca. 0.2 mm long) and ascending to erect; terminal buds densely yellowish pubescent, the hairs very short and ascending to erect, completely covering the buds. Leaves 4–11 × 2.3–5 cm, chartaceous, elliptic to ovate-elliptic, alternate, the base acute, the margin plane, the apex acute or shortly acuminate, both surfaces glabrous, or a few minute, erect hairs present along the midrib; midrib and lateral veins slightly impressed, tertiary venation immersed and not discernable on the upper surface, midrib and lateral veins raised, tertiary venation scarcely raised or immersed on the lower surface; domatia lacking; lateral veins 4 to 6; petioles 5–10 mm, flat or shallowly canaliculate above, with an indument like that of the twigs. Inflorescences 3–7 cm, racemose or with short lateral branchlets terminating in a cyme, the pistillate inflorescences shorter and with fewer flowers than the staminate ones, sparsely pubescent to subglabrous, in the axils of leaves. Flowers 3–4 mm diam., greenish yellow, unisexual. Male flowers: tepals 1.5 mm, broadly elliptic to triangular, glabrous on both surfaces or with a few appressed hairs near the base of the inner surface, erect or half-erect; stamens 9, 4-celled, the outer six 1.2 mm, the filament 0.4 mm, glabrous, the cells arranged in 2 rows, introrse,

Figures 1—4 (clockwise from top left). —1. *Ocotea adela* van der Werff, holotype photo (MO). —2. *Ocotea atlantica* van der Werff, holotype photo (MO). —3. *Ocotea darcyi* van der Werff, isotype photo (MO). —4. *Ocotea haberi* van der Werff, isotype photo (CAS).

inner 3 the same size, but the cells extrorse, glands present at the base of the filaments, staminodia not seen, pistillode 1.6 mm, glabrous, slender, sometimes with a dark tip, receptacle narrow, rather deep, with some appressed hairs inside; female flowers: tepals as in male flowers, staminodia 9, 0.6 mm, pistil glabrous, 2.5 mm, the style 0.5 mm, receptacle deep, sparsely appressed pubescent inside. Fruits subglobose, 8 × 7 mm, the cupule shallowly bowl-shaped, 6 mm diam., the tepals per-

sistent on the cupule, the margin simple, pedicel conically thickened toward the cupule.

Phenology. Flowers November–February; fruits January, March.

Ocotea adela is, as the name suggests, not a striking species. The shallow cupule with persistent tepals and the conically thickened pedicel are the best clues to its relationships, and these characters point toward *O. camphoromoea* Rohwer, a species known from Amazonian Brazil. Like *O. adela,* this species is a shrub or a small tree, has short, little-branched inflorescences, and somewhat impressed midribs and lateral veins on the upper leaf surface. *Ocotea camphoromoea* differs, however, in its larger leaves, appressed hairs on the terminal buds and young twigs, and its distribution. According to Rohwer (1986), *O. camphoromoea* and its relatives have a pistillode with a distinct stigma in the staminate flowers, but he cautioned that this character can be variable. In *O. adela* the stigma on the pistillode is lacking in some flowers; in others it is only indicated by a discoloration at the tip of the pistillode. Currently, *O. adela* is only known from the Cerro Jefe–Cerro Azul area near Panama City. Among the Panamanian species it is best recognized by its unisexual flowers, short, nearly glabrous inflorescences, leaves with slightly impressed lateral veins and midrib, the shallow cupules with persistent tepals, and the thickened pedicels in fruit.

Paratypes. PANAMA. **Panamá:** Cerro Jefe, *Duke 9434* (MO), *Dwyer 7091* (MO), *Valdespino & Solis 259* (MO); Cerro Azul, P.N. Chagres, *Carrasquilla & Rios 3345* (MO); Cerro Azul Lake, *Folsom et al. 1973* (MO); La Eneida, *Galdames & Guerra 1940* (MO).

Ocotea atlantica van der Werff, sp. nov. TYPE: Honduras. Atlántida: La Ceiba, 28 Nov. 1991, *N. Zamora 1744* (holotype, MO). Figure 2.

Ocoteae leucoxylon affinis, sed foliis subtus pilosis, ramulis inflorescentiisque tomentellis recedit.

Trees to 25 m tall. Twigs terete or slightly angular, densely brown tomentose when young, the surface not visible, glabrescent with age; terminal buds densely brown tomentose. Leaves 12–23 × 3.5–9 cm, alternate, chartaceous, (narrowly) elliptic, the base acute to obtuse, the apex acuminate or acute, the acumen to 1 cm long, the upper surface glabrous except for the tomentellous midrib, the lower surface pilose and soft to the touch, the indument denser along the veins and the midrib tomentose; midrib, lateral veins, and tertiary venation immersed or the major veins slightly impressed on the upper surface, midrib and lateral veins raised, tertiary venation slightly raised on the lower surface; domatia lacking; lateral veins 5 to 8, the distal ones sometimes loop-connected near the margin; petioles 1–2.5 cm, terete, with an indument like that of the twigs. Inflorescences 2–10 cm, brown tomentellous, paniculate-cymose or by reduction racemose, in the axils of leaves. Flowers unisexual, cream colored, 3–3.5 mm diam., moderately to sparsely appressed pubescent, the indument less dense than on the inflorescence branchlets. Male flowers: tepals ca. 1 mm long, broadly elliptic, sparsely appressed pubescent outside, glabrous inside, outer 6 stamens ca. 0.8 mm long, glabrous, the anther ca. 0.6 mm long, the cells introrse, arranged in 2 pairs, a sterile tip lacking; inner 3 stamens like the outer ones, but with 2 globose glands near the base of the filaments and the anther cells extrorse; staminodia not seen; pistillode 1 mm long, glabrous, threadlike, with a stigma; receptacle small, pocket-like, pubescent inside; female flowers: tepals as in male flowers or with some pubescence on the inner surface, united at the base and falling off as one unit in old flowers, staminodia 9, 0.5 mm long, the inner 3 with 2 glands near the base; pistil 1.5 mm long, glabrous, with a distinct stigma; receptacle glabrous inside. Fruits roundish, ca. 8 × 6 mm, cupule shallowly bowl-shaped, lenticellate, the pedicel swollen.

Phenology. Flowers November–February; fruits April–May.

Ocotea atlantica is restricted to wet lowland forests on the Atlantic slopes of Costa Rica, Nicaragua, and Honduras. It is one of the two *Ocotea* species with unisexual flowers endemic to Central America, the other being *O. adela.* The shallow, lenticellate cupules and the flowers with a much sparser indument than found on the peduncles and inflorescence branchlets point to a relationship with the widespread *Ocotea leucoxylon* (Swartz) Lanessan. However, the latter species lacks the pilose indument on the lower leaf surface and the tomentose or tomentellous indument on the young twigs and inflorescences. I have earlier annotated a few of the cited paratypes as *O. leucoxylon,* and duplicates may have been distributed under this name.

Paratypes. COSTA RICA. **Alajuela:** Boca Tapado, *Jimenez et al. 1124* (MO). **Heredia:** Cuenca del Sarapiqui, *Hammel 20664, 20708 & 20710* (all MO); Finca El Bejuco, *Grayum et al. 4611* (MO). NICARAGUA. **Río San Juan:** *Rueda et al. 5653* (MO). HONDURAS. **Atlántida:** Municipio de Esparta, *Brant & Hazlett 2868* (MO); Montana del Rayo, *Nelson 5494* (MO), *Martinez 178* (MO); Campamento Grande, at the N base of Pico Bonito, *Liesner 26149, 26174 & 26366* (all MO), *Evans 1064 & 1655* (MO), *Nelson et al. 19124* (TEFH). **Yoro:** valley of the Rio Lean, vicinity of Las Lomas, *Davidse et al. 34465*

(MO); Cordillera Nombre de Dios, S of San Jose de Texiguat, *Davidse et al. 34505* (MO).

Ocotea darcyi van der Werff, sp. nov. TYPE: Panama. Panamá: Parque Nacional Altos de Campana, 3 Sep. 1999, *M. Correa, M. Sanchez & J. Deago 11554* (holotype, PMA; isotypes, BM, CR, HBG, MEXU, MO). Figure 3.

Ab *Ocotea pseudopalmana* floribus minoribus, inflorescentiis multifloris indumentoque ferrugineo differt.

Trees to 20 m. Twigs angular, densely ferruginous tomentellous, the surface completely covered by the indument, terminal buds densely ferruginous tomentellous. Leaves 9–15 × 4–7 cm, alternate, coriaceous, obovate to obovate-elliptic, the base acute to cuneate, flat, the apex obtuse or with a very short acumen, the upper surface sparsely or moderately pubescent, but soon becoming glabrous except for the tomentellous major veins, the lower surface densely ferruginous pubescent, the hairs erect, the surface visible between the hairs, the major veins densely tomentellous and completely covered by the indument; midrib, lateral veins, and tertiary venation immersed on the upper surface, raised to prominently raised on the lower surface; lateral veins 6 to 8, domatia lacking; petioles 5–8 mm long, with an indument like that of the twigs. Inflorescences 10–20 cm, paniculate-cymose, many-flowered, densely ferruginous tomentellous, the surface completely covered by the indument, mostly in the axils of bracts near the tips of the twigs, less frequently in the axils of leaves. Flowers 4–4.5 mm diam., perfect. Tepals 1.5 mm long, densely pubescent on both surfaces, half-erect at anthesis; stamens 9, 4-celled, the outer six 0.9 mm long, the filament ca. 0.4 mm long, pubescent, the anther glabrous, the cells arranged in 2 pairs, opening introrse, a sterile tip lacking, inner 3 stamens 1.1 mm long, the filament and the base of the anther pubescent, the cells arranged in 2 pairs, the lower pair opening extrorse, the upper pair lateral, glands present at the base of the filaments, staminodia not seen, pistil glabrous, 2 mm long (but already developing into young fruit); receptacle cup-shaped, with a ring of hairs in the upper part, otherwise glabrous. Fruits globose, 1–1.4 cm diam., cupule very shallow to plate-like, 9 mm diam., with a single margin, the tepals not persisting.

Phenology. Flowers (old) November; fruits May.

Ocotea darcyi is known from a few collections, all from Cerro Campana in Panama. The new species can be confused with *O. pseudopalmana* W. Burger, but differs in its multi-flowered and much-branched inflorescences, its ferruginous indument, and smaller flowers. *Ocotea darcyi* is probably more closely related to *O. stenoneura* Mez & Pittier; the two species share a similar indument (the hairs on the leaves of *O. pseudopalmana* are much shorter and not as straight), fruit shape and cupule shape, the dense pubescence on inner and outer surface of the tepals, and the ladder-like pattern of the intersecondary veins. However, *O. stenoneura* differs in its inrolled and decurrent leaf bases, its acute leaf apices, and its elliptic leaf shape.

I dedicate this species to William G. D'Arcy as a tribute to his life and work. His involvement with the *Flora of Panama* was very deep; his contributions will always be with us.

Paratypes. PANAMA. **Panamá:** Parque Nacional Altos de Campana, *Correa & Montenegro 9558, 10176, 10389* (all MO), *Correa & Sanchez 11556* (MO), *Galdames et al. 3891 (MO).*

Ocotea haberi van der Werff, sp. nov. TYPE: Costa Rica. Guanacaste: 4–5 km NW of Monteverde, 11 Apr. 1992, *W. Haber, C. Guindon & D. Brenes 11093* (holotype, MO; isotype, CAS). Figure 4.

Ocoteae mezianae similis, sed floribus pubescentibus, receptaculo intus pubescenti et domatiis folliculis recedit.

Trees, to 20 m tall. Twigs angular, moderately to sparsely appressed pubescent, becoming glabrous with age, solid; terminal buds densely appressed pubescent. Leaves 6–16 × 2–5 cm, chartaceous to papyraceous, alternate, elliptic to obovate-elliptic, the base acute to cuneate, margin plane, the apex obtuse, acute or shortly acuminate, acumen to 8 mm long, upper leaf surface glabrous except the sometimes appressed pubescent midrib, lower surface sparsely appressed pubescent to glabrous, the indument denser along the midrib; midrib, lateral veins, and tertiary venation immersed on the upper surface, midrib and lateral veins raised, tertiary venation slightly raised or immersed on the lower surface; pit or pocket domatia present in the axils of the basal lateral veins, these usually visible as small bumps on the upper leaf surface; lateral veins 3 to 6; petioles 6–13 mm long, canaliculate, sparsely appressed pubescent or glabrous. Inflorescences 4–10 cm long, racemose or with several cymes near the base of the inflorescences and the distal part racemose, moderately to sparsely appressed pubescent, in the axils of leaves. Flowers 4 mm diam., yellow, perfect. Tepals ca. 1.7 mm, sparsely appressed pubescent outside, sparsely to moderately pubescent inside, half-erect at anthesis, stamens 4-celled, the cells arranged in 2 pairs, outer six 1.2 mm, glabrous, the anthers 0.7 mm, without a sterile

tip, the cells opening introrse; inner three 1.4 mm, glabrous or with the filaments pubescent, the anthers ca. 1 mm long, as wide as the filaments, the cells opening extrorse, the filaments with 2 glands at the base; staminodia 3, narrowly cylindrical, pistil slender, 1.7 mm long, glabrous, the ovary much shorter than the style; receptacle deeply cup-shaped, pubescent inside. Fruits 25 × 13 mm, ellipsoid or ovoid; cupule deeply cup-shaped when young, the tepals sometimes persisting, at maturity plate-like, 1 cm diam., with a single margin.

Phenology. Flowers March–May; fruits November–February.

Ocotea haberi is an inconspicuous species, best recognized by the combination of pubescent flowers, pit or pocket domatia (often the opening is much smaller than the domatium), and the pubescent inside of the receptacle. The other species with pit domatia have glabrous flowers and a glabrous inside of the receptacle. The immature cupules are deeply cup-shaped unlike cupules of the other species with pit domatia, but mature cupules become plate-like. The twigs of dried specimens have frequently very light-colored bark, while the other species in the *O. meziana* group tend to have darker-colored twigs. *Ocotea holdridgeiana* W. Burger also has conspicuous domatia in the axils of the basal lateral veins, but it differs in having much larger flowers (1 cm diam.) and anthers with a sterile tip. *Ocotea haberi* is only known from montane forests in Costa Rica and Panama.

This species is named after W. Haber, whose excellent collections have added much to our knowledge of the flora of the Monteverde area in Costa Rica.

Paratypes. COSTA RICA. **Alajuela:** Monteverde, *Guindon 49* (MO); Bosque Eterno de Los Ninos, *Haber & Zuchowski 11158* (MO). **Guanacaste:** Cordillera de Tilaran, *Guindon 39* (MO). **Puntarenas:** Bosque Eterno de Los Ninos, *Bello et al. 2155* (MO); Monteverde, *Penneys 461* (MO); Monteverde, Rio Guacimal, *Bello 2095* (MO); Las Cruces, *Vargas et al. 1318* (MO); Canas Gordas, *Croat 22246* (MO). PANAMA. **Coclé:** N rim of El Valle, *Allen 1907* (MO).

Ocotea jefensis van der Werff, sp. nov. TYPE: Panama. Panamá: Cerro Jefe, 12 Sep. 1985, *L. Carrasquilla 2123* (holotype, MO). Figure 5.

Ex affinitate *Ocoteae insularis*, sed ramulis angulatis fistulosisque diversa est; ab *O. atirrense* inflorescentiis floribusque tomentellis recedit.

Small tree, to 15 m. Twigs thick, prominently angled, minutely and rather densely appressed pubescent when young, glabrescent with age, hollow, with exit holes for the twig-inhabiting ants; terminal buds densely appressed pubescent. Leaves 16–21 × 8–12 cm, alternate, broadly obovate, coriaceous, the base decurrent on the short petiole, the apex obtuse to rounded, glabrous on both surfaces, midrib broad and immersed, lateral veins immersed and tertiary venation raised on the upper surface, midrib, lateral veins, and tertiary venation raised on the lower surface, domatia lacking, lateral veins 7 to 9; petioles not distinct due to the decurrent, inrolled leaf bases, 5–10 mm long, flat. Inflorescences 15–20 cm long, sparsely pubescent near the base but toward the flowers progressively more densely tomentellous, the hairs very short and spreading; in the axils of leaves; paniculate-cymose; the branchlets angular or flattened. Flowers hermaphrodite, ca. 4 mm diam. Tepals 1.3 mm long, ovate to elliptic, rather densely and minutely pubescent outside, glabrous inside, outer 6 stamens ca. 1 mm long, glabrous, the filament ca. 0.3 mm long, the anther cells introrse in two pairs; inner three as long as the outer ones, with a few hairs on the distal part of the filament, the lower two cells extrorse, the upper two latrorse, glands present at the base of the filaments of the inner three stamens; staminodia not seen; pistil ca. 1.5 mm long, glabrous; receptacle cup-shaped, glabrous inside. Immature fruits largely enclosed in the deeply cup-shaped cupule, at maturity fruits narrowly ellipsoid, 15 × 6 mm, the cupule small, bowl-shaped, 5–6 mm tall and 6 mm wide.

Phenology. Flowers August–September; fruits January–February.

Ocotea jefensis is a member of the *Ocotea insularis* group sensu Rohwer (1986) based on the flattened inflorescence branches and the tuft of hairs on the adaxial side of the filaments of the inner 3 stamens. Within this group it shares with *O. atirrensis* Mez & J. D. Smith s.l. the hollow, ant-inhabited twigs, but differs in its tomentellous flowers and inflorescences, in its indistinct petioles due to the decurrent, incurved leaf bases and the coriaceous, broadly obovate leaves with the raised tertiary venation. With *O. insularis* (Meisner) Mez s.l. the new species shares the obovate leaf shape with decurrent base, but it differs from *O. insularis* in its thick, hollow twigs, the coriaceous leaves with raised tertiary venation, and the tomentellous flowers and inflorescences. *Ocotea tonduzii* Standley, a montane species from Costa Rica, can also be confused with *O. jefensis*. Like *O. jefensis*, *O. tonduzii* has glabrous, obovate leaves with raised tertiary venation and tomentellous flowers, but it differs in its solid, glabrous twigs, its largely or entirely glabrous terminal buds, the less pubescent inflorescences,

Figures 5—8 (clockwise from top left). —5. *Ocotea jefensis* van der Werff, holotype photo (MO). —6. *Ocotea klepperae* van der Werff, isotype photo (MO). —7. *Ocotea macrantha* van der Werff, holotype photo (MO). —8. *Ocotea oblongifolia* van der Werff, holotype photo (US).

and the pubescence on the inner surface of the tepals.

Ocotea jefensis is only known from Cerro Jefe and the El Llano–Carti Rd. in Panama; the collection from San Blas differs from the others in having less coriaceous leaves.

Paratypes. PANAMA. **Panamá:** Cerro Jefe, *Aranda B. 386* (MO); El Llano–Carti Rd., *Mori 7745* (MO). **Com-**

arca de San Blas: Cerro San Jose, *de Nevers & Herrera 6952* (MO).

Ocotea klepperae van der Werff, sp. nov. TYPE: Costa Rica. Puntarenas: Valle del Pelo Seco, 21 Feb. 2000, *B. Hammel 22068* (holotype, INB; isotype, MO). Figure 6.

A ceteris speciebus *Ocoteae* subgeneris *Dendrodaphne* floribus, inflorescentiis ramulisque dense pubescentibus pilis erectis praeditis recedit.

Trees, to 8 m. Twigs terete, solid, densely pubescent, the hairs erect and completely covering the surface; terminal buds similarly densely pubescent. Leaves 8–16 × 3–6 cm, elliptic, chartaceous, alternate, the base obtuse or acute, the margin plane, the apex acute or slightly acuminate, the upper surface glabrous, the lower surface sparsely pubescent, the hairs erect and discernable to the touch, the indument denser along the lateral veins and largely or entirely covering the midrib; midrib and lateral veins immersed but visible, tertiary venation immersed and not visible on the upper surface, midrib and lateral veins raised, tertiary venation moderately raised on the lower surface; domatia absent; lateral veins 5 to 7 pairs; petioles 5–8 mm long, with an indument like that of the twigs, canaliculate, the indument wearing off with age and then petioles darker in color than the twigs. Inflorescences 5–8 cm long, in the axils of bracts mostly near the tips of the twigs, less frequently in the axils of bracts along the twigs, paniculate-cymose, densely pubescent, the surface completely covered by the erect hairs. Flowers 1 cm diam., perfect. Tepals 4–4.5 mm long, narrowly elliptic to oblong, spreading at anthesis, densely pubescent on both surfaces, stamens 9, densely covered with hair-like papillae, the outer six 2.5 mm long, tongue-shaped, the sterile tip ca. 1 mm long, the cells arranged in 2 pairs and introrse, the inner three 2.5 mm long, columnar, the cells extrorse-lateral, in 2 pairs, with 2 glands 1–1.5 mm long at their base, the glands covering part or most of the lower pair of anther cells; staminodia absent or rarely one present, then 1.5 mm long, stipitate; pistil 2.5 mm long, glabrous, the style 1 mm long; receptacle deeply cup-shaped, densely pubescent inside. Fruit and cupule unknown.

Phenology. Flowers February, March.

The tongue-shaped, papillose stamens with a sterile tip, large flowers, and the position of the inflorescences in axils of bracts near branch tips places this new species in *Ocotea* subg. *Dendrodaphne*. It differs from the other species in this subgenus in its dense indument on twigs, inflorescences, and flowers. *Ocotea klepperae* further differs from the common *O. veraguensis* (Meisner) Mez and *O. dendrodaphne* Mez in having shorter inflorescences with fewer flowers.

The indument of twigs, inflorescences, and flowers is less dense on the paratype; in other characters, such as the few-flowered inflorescences and obtuse leaf base, it agrees with the type collection.

It is a pleasure to name this species after Nancy Klepper in recognition of her keen interest in the people and culture of Latin America.

Paratype. COSTA RICA. **Puntarenas:** P.N. Manuel Antonio, *Harmon 82* (MO).

Ocotea macrantha van der Werff, sp. nov. TYPE: Costa Rica. Puntarenas: Canton de Osa, 8 Sep. 1996, *R. Aguilar 4688* (holotype, MO; isotype, INBIO). Figure 7.

Ocoteae rubriflorae affinis, sed floribus majoribus recedit.

Trees, 20 m. Twigs ridged to angular, solid, densely and minutely brown tomentellous, the surface completely covered and individual hairs scarcely recognizable; terminal buds completely covered with the same type of indument. Leaves 19–26 × 7–12 cm, alternate, chartaceous, elliptic, the base obtuse, rarely acute, the margin flat, the apex acuminate or acute, acumen to 2 cm long, the upper surface glabrous except for some minute hairs on the major veins, the lower surface sparsely to moderately minutely puberulous, the individual hairs scarcely visible, the indument denser and becoming tomentellous along the major veins, midrib and lateral veins immersed, tertiary veins slightly raised on the upper surface, midrib prominently raised, lateral veins raised and tertiary venation weakly raised on the lower surface; domatia absent; lateral veins 7 to 10; petioles 2–3 cm, sulcate, with a dense, brown indument like that of the twigs. Inflorescences 9–17 cm, in the axils of normal leaves, paniculate-cymose, the axes densely and minutely brown tomentellous, the surface completely covered. Flowers 10–12 mm diam., pale green, perfect. Tepals 4–5 mm, elliptic, spreading at anthesis, the outer 3 sparsely to moderately puberulous outside and with a basal triangular papillose patch, otherwise glabrous inside, the inner 3 tepals densely and coarsely papillose on both surfaces, sometimes appearing floccose on the outer surface; stamens 1.6 mm, densely papillose, the outer 6 with the cells arranged in 2 pairs, opening introrse, the cells filling nearly the entire anther, the inner 3 with the lower pair of cells extrorse, the upper pair lateral, small glands present at the base of the filaments of

the inner 3 stamens, staminodia not seen; pistil 3–4 mm, glabrous, the style a little shorter than the ovary; receptacle deeply cup-shaped, densely appressed pubescent inside. Fruit ellipsoid, 28 × 14 mm, the cupule bowl-shaped, 14 mm diam., the tepals not persisting and with a single margin; pedicel slightly thickened in fruit.

Phenology. Flowers September; fruits December.

The large, perfect flowers with spreading tepals, the tepals at least partially papillose on the inner surface, and the short indument point to a placement of *O. macrantha* in the *O. heydeana* group as defined by Rohwer (1991). Vegetatively, *O. macrantha* is very similar to *O. rubriflora* Mez. The peculiar short and dense indument of the twigs and inflorescences is not found in any other species of the *O. heydeana* group, and the pubescent outer surface of the tepals, shared by both species, is also very unusual in the group. Flowering material of *O. macrantha* can be readily identified by the size of the flowers: 10–12 mm in diameter for *O. macrantha* vs. 6–7 mm in *O. rubriflora.*

Paratype. COSTA RICA. **Puntarenas:** Canton de Osa, *Aguilar 4785* (MO).

Ocotea oblongifolia van der Werff, sp. nov. TYPE: Guatemala. Quezaltenango: Finca St. John, ca. 5 km S of Sta. Maria de Jesus, 17 May 1966, *J. W. Walker 442* (holotype, US; isotype, BR). Figure 8.

A congeneris foliis basi obtusis vel subcordatis, ramulis paginisque inferioribus foliorum dense pubescentibus et floribus parvis, hermaphroditis recedit.

Small tree, 6 m. Twigs terete, solid, densely light brown pubescent with mostly erect, straight hairs, the surface of the twigs completely covered or nearly so; terminal buds completely covered by the dense, light-brown, erect indument. Leaves 9–13 × 3–5 cm, oblong to slightly ovate-oblong, chartaceous, alternate, the base obtuse to subcordate, the apex gradually acute, the upper surface sparsely pubescent with erect hairs, the indument much denser along the major veins, the lower surface densely pubescent with erect hairs, these soft to the touch, the surface partially visible between the hairs, the pubescence denser along the major veins and these clearly visible; midrib, lateral veins, and tertiary venation immersed on the upper surface, midrib and lateral veins raised, tertiary venation immersed on the lower surface; domatia lacking; lateral veins 7 to 10; petioles 6–8 mm long, terete, with the same dense indument as the twigs. Inflorescences 4–6 cm long, in the axils of leaves, paniculate-cymose, rather few-flowered, sparsely to moderately pubescent with erect hairs. Flowers 2–3 mm diam., cream colored, perfect. Tepals 1–1.2 mm long, erect to half-erect at anthesis, hypanthium and tepals sparsely pubescent on the outer surface, glabrous inside, stamens 9, all 4-celled, ca. 0.7 mm long, glabrous, anthers sessile or nearly so, the cells arranged in 2 superposed pairs, filling the entire anther and a sterile tip absent, outer 6 stamens with the cells opening introrse, inner 3 with the cells opening lateral-extrorse, glands present at the base of the inner 3 stamens, staminodia small, triangular, glabrous; pistil 1.5 mm, glabrous, receptacle deep, cup-shaped. Fruits and cupules not seen.

Phenology. Flowers May.

Ocotea oblongifolia can be readily recognized by the combination of oblong, densely pubescent leaves with an obtuse to subcordate base, and the small, hermaphroditic flowers. The soft, villous indument is similar to that found in the *O. helicterifolia* group (van der Werff, 1999), but the small flowers with erect to half-erect tepals that lack the papillose indument so typical of the *O. helicterifolia* group, suggest it is not related to that group. Morphologically, *O. oblongifolia* is quite distinct and it is described based on only the type collection. Its relationships are not clear.

Ocotea pullifolia van der Werff, sp. nov. TYPE: Costa Rica. Puntarenas: Canton de Golfito, 24 Aug. 1990, *G. Herrera 4119* (holotype, INB). Figure 9.

Ocoteae jorge-escobarii similis, sed domatiis paucis, magnis profundisque et foliis apice obtusis recedit.

Trees, to 25 m. Twigs angular, solid, the very tip sparsely to moderately appressed pubescent, but soon becoming glabrous; terminal buds densely appressed pubescent, the hairs white and often contrasting with the dark leaves and twigs. Leaves 7–15 × 2.5–5 cm, coriaceous, elliptic to obovate-elliptic, alternate, becoming close together near the tips of the branches, the base acute to cuneate, the margin flat or slightly inrolled, the apex obtuse or rounded, glabrous on both surfaces or with a few appressed hairs on the lower surface; midrib, lateral veins, and tertiary venation immersed to raised on the upper surface, raised on the lower surface; domatia, as deep pits, usually present, few, in the axils of the basal lateral veins, not along the secondary veins, glabrous, visible as bulges on the upper surface; lateral veins 4 to 7;

Figure 9. *Ocotea pullifolia* van der Werff, holotype photo (INB).

petioles 6–11 mm, glabrous, strongly ridged above. Inflorescences 4–7 cm, in the axils of leaves, paniculate-cymose, glabrous or very sparsely appressed pubescent. Flowers 4–5 mm diam., green, perfect. Tepals 1.8 mm, glabrous on both surfaces, spreading in old flowers; stamens 9, 4-celled, the outer six 1.2 mm, glabrous, the filaments as long as the anthers, anther cells arranged in 2 pairs, introrse; inner 3 stamens as long as the outer 6, the anther cells opening extrorse, the filaments broad, as long as the anthers, with a patch of white hairs at the base of the anther on the side facing the pistil; filaments with 2 large glands at the base; staminodia not seen; pistil 1.5 mm, glabrous, the style about as long as the ovary; receptacle cup-shaped, glabrous inside. Fruits ellipsoid, 2.6 × 1.8 cm, cupule cup-shaped, 2 cm diam., 1 cm high, with a simple margin, the tepals not persisting.

Phenology. Flowers June, August; fruits during most of the year.

Ocotea pullifolia is closely related to *O. jorge-escobarii* C. Nelson but differs in having domatia restricted to the axils of the basal lateral veins, in the small number of domatia, and in having the leaf apices obtuse. In *O. jorge-escobarii* the small domatia are found along the lateral veins, and the leaf apices are bluntly acute.

The domatia are more common in collections from Costa Rica than in those from Panama; sometimes only one leaf from a Panamanian specimen might show 1 or 2 domatia, and in a few collections domatia are lacking altogether. In that case, the dark-drying leaves, the raised reticulation, and the obtuse leaf apices make an identification possible. On Cerro Jefe in Panama *O. pullifolia* occurs together with *O. whitei* Woodson s.l., and the two can resemble each other strongly. They can be separated by the much larger cupules of *O. pullifolia*, and the more scalariform reticulation on the upper leaf surface found in *O. whitei* s.l.

Several collections here placed in *O. pullifolia* have been previously distributed as *O. jorge-escobarii*.

Paratypes. COSTA RICA. **Puntarenas:** Osa Peninsula, *Thomsen 22* (MO), *Hammel et al. 16874* (MO), *Aguilar 1211* (MO), *Hammel & Robles 16777* (MO). PANAMA. **Chiriquí:** *McPherson 9131* (MO), *McPherson 9608* (MO). **Coclé:** *Hammel & Kress 11300* (MO, CAS). **Colón:** *McPherson 10266* (MO), *Mori & Kallunki 5059* (MO). **Panamá:** *McPherson 8494, 10007* (both MO), *McPherson & Merello 8121* (MO), *D'Arcy & Hamilton 14798* (MO), *Carrasquilla et al. 3246* (MO), *Carrasquilla & Zapata 3621* (MO), *Correa & Dressler 731* (MO), *Montenegro 1400* (MO).

Ocotea amplifolia (Mez & Donnell Smith) van der Werff, comb. nov. Basionym: *Phoebe amplifolia* Mez & Donnell Smith, Bot. Gaz. 19: 261. 1894. *Cinnamomum amplifolium* (Mez & Donnell Smith) Kostermans, Reinwardtia 6: 20. 1961. TYPE: Guatemala. El Jute, *E. T. Heyde & E. Lux 3033* (isotype, GH).

The presence of relatively large staminodia probably led Mez to describe this species as a *Phoebe*. Currently the neotropical species formerly placed in *Phoebe* are considered to belong to *Cinnamomum*. However, *Ocotea amplifolia* differs from *Cinnamomum* in having densely pubescent, spreading tepals, which do not persist on the cupule, in having a shallowly cup-shaped cupule (ex descr. Mez & Donnell Smith), and in lacking domatia or tripliveined leaves.

Ocotea parvula (Lundell) van der Werff, comb. nov. Basionym: *Phoebe parvula* Lundell, Wrightia 5: 343. 1977. *Cinnamomum parvulum* (Lundell) Kostermans, Reinwardtia 10: 448. 1988. TYPE: Mexico. Chiapas: *Ton 605* (holotype, LL).

This species was excluded from *Cinnamomum* by Lorea-Hernandez (1996) and is closely related to *Ocotea strigosa* van der Werff from Nicaragua.

Ocotea vanderwerffii (Kostermans) van der Werff, comb. nov. Basionym: *Phoebe glabra* van der Werff, Ann. Missouri Bot. Gard. 74: 406. 1987. *Cinnamomum vanderwerffii* Kostermans, Reinwardtia 10: 454. 1988. TYPE: Mexico. Oaxaca: *T. Wendt et al. 4813* (holotype, MO).

This species was excluded from *Cinnamomum* by Lorea-Hernandez (1996), and I agree with him that it is better placed in *Ocotea.* It is closely related to *O. bernoulliana* Mez. Kostermans (1988) published a nomen novum for this species because *Cinnamomum glabrum* Hort. ex Ettingshausen had already been used for a different species. Similarly, *Ocotea glabra* van der Werff precludes a new combination of *P. glabra* in *Ocotea* and makes it necessary to continue the use of Kostermans's epithet.

Acknowledgments. I thank the curators of the herbaria cited above for the loan of specimens. Fred Keusenkothen kindly scanned the type specimens from which the illustrations are made.

Literature Cited

Allen, C. K. 1945. Studies in the Lauraceae VI. A preliminary survey of the Mexican and Central American species. J. Arnold Arbor. 26: 280–434.

Kostermans, A. J. G. H. 1988. Materials for a revision of Lauraceae V. Reinwardtia 10: 439–469.

Lorea-Hernandez, F. G. 1996. A Systematic Revision of the Neotropical Species of *Cinnamomum* Schaeffer (Lauraceae). Ph.D. Thesis, University of Missouri-St. Louis.

Rohwer, J. G. 1986. Prodromus einer Monographie der Gattung *Ocotea* Aubl. (Lauraceae) sensu lato. Mitt. Inst. Allg. Bot. Hamburg 20: 1–278.

———. 1991. Borderline cases between *Ocotea, Nectandra,* and *Phoebe* (Lauraceae): The "marginal" species of the *Ocotea helicterifolia*-group, including the *O. heydeana*-group. Bot. Jahrb. Syst. 112: 365–397.

Werff, H. van der. 1999. New taxa and combinations in the *Ocotea helicterifolia* (Lauraceae) species group. Novon 9: 571–583.

Arisaema danzhuense (Araceae), a New Species from the Gaoligong Mountains, Northwestern Yunnan, China

Yi Tingshuang and Li Heng

Kunming Institute of Botany, Chinese Academy of Sciences, Heilongtan, Kunming, Yunnan 650204, People's Republic of China

ABSTRACT. *Arisaema danzhuense* T. S. Yi & H. Li (sect. *Trisecta*) is described as a new species from the Gaoligong Mountains, northwestern Yunnan, China. It is closely related to *A. propinquum* Schott but differs in having a greenish spathe with white stripes and a round apex with an acumen 5 mm long, a greenish petiole and peduncle densely verruculose with whitish spinules, and the terminal leaflet with an acute apex.

Key words: Araceae, *Arisaema*, China.

The genus *Arisaema* Martius is a North Temperate genus comprised of about 170 species (Li, 1980; Mayo et al., 1997). There are 93 species in China (Li & Long, 1998); 35 species are distributed in the Gaoligong Mountains (Li, 2000). The genus has been divided into 10 or 13 sections (Hara, 1971; Murata, 1984). Section *Trisecta* Schott is one of the largest, comprising 15 species that are distributed in Burma, the Himalayas, and western China (Murata, 1984). The section can be distinguished from the other sections by having anthers dehiscing by a horseshoe-shaped slit and the base part of appendix swelling into a disk. *Arisaema danzhuense* is easily recognized as a member of this section with these characters.

Rising between the great Salween and Irrawaddy Rivers, the Gaoligong Mountains lie in the border area between southwestern China and northern Myanmar. There are 4303 species of seed plants recorded in the Chinese part of the Gaoligong Mountains (Li, 2000), thus making it one of the richest biological resource areas in the world.

Arisaema danzhuense T. S. Yi & H. Li, sp. nov. TYPE: China. Yunnan: Gongshan Xian, Danzhu, 3000 m, 1 July 2000, *Li Heng, Bruce Bartholomew & Philip Thomas et al. 12101* (holotype, KUN; isotypes, E, MO). Figure 1.

Haec species *Arisaemati propinquo* Schott affinis, sed ab eo petiolo et pedunculo viridibus, verrucosis, spinulis albidis armatis, foliolorum marginibus purpureis, undulatis, spatha viridi striis albidis ornata in acumen 5 mm longum apice rotundatum desinente atque spadicis appendice viridi differt.

Perennial dioecious herb. Tuber subglobose, 1.5–5 cm diam., brown outside, bearing 5–10 tubercles 0.5–1 cm diam., easily separated from the mother tuber. Cataphylls 2 or 3, oblong-elliptic, to 20 × 5 cm, membranous, greenish. Leaf 1; petiole cylindric, 40–60 × 0.5–2.5 cm, greenish, densely verruculose with whitish spinules, sheathed in proximal 1/3; leaf blade trifoliolate; leaflets sessile or subsessile, green above with dark purple maculations, greenish below, the margins purple; midrib and lateral veins elevated beneath, verruculose with whitish spinules; terminal leaflet depressed rhombic, 15–21 × 16–20 cm, acute at the apex, broadly cuneate at the base, with 7 lateral veins per side, the connective veins 3, 1–15 mm from the margin; lateral leaflets obliquely ovate, 20–30 × 15–21 cm, acuminate at apex, broadly cuneate at the base. Peduncle 40–50 × 0.7–1.2 cm, emerging from petiole sheath, greenish, verruculose and spinulescent. Spathe greenish with white stripes, pale green inside with about 20 longitudinal laminae 1–3 mm wide; tube cylindric, 5 × 3 cm, the throat margins slightly recurved; limb oblong, incurved, 8 × 2–5 cm, the apex rounded with acumen 0.5 cm. Spadix unisexual. Female spadix: fertile portion cylindric, 5.5 × 0.7–1.6 cm; the flowers dense; ovary oblong-ovate, 5 × 2 mm, pale green with green stripes, the style short, the stigma white, pilose; ovules 9, subbasal, erect; appendix flagelliform, 14 cm long, the upper part filiform, tortuous, smooth, greenish, the base swollen to 6 mm diam., truncate and stipitate, the stipe 3 mm long. Male spadix: fertile portion cylindric, 3 × 0.8 cm diam.; synandria stipitate, the stipe 1 mm long; anthers 3 to 5 (mostly 4), obovate, whitish, dehiscing by a horseshoe-shaped slit; apendix as in female spadix.

Distribution. Known only from Gongshan Xian, on the east slope of the Gaoligong Mountains, northwestern Yunnan, China; 3000 m above sea level; in a meadow by a river, among shrubs on a slope.

Arisaema danzhuense is most similar to *A. propinquum* Schott, which is from southern Xizang, China, India, Nepal, Pakistan, Sikkim, and Bhutan

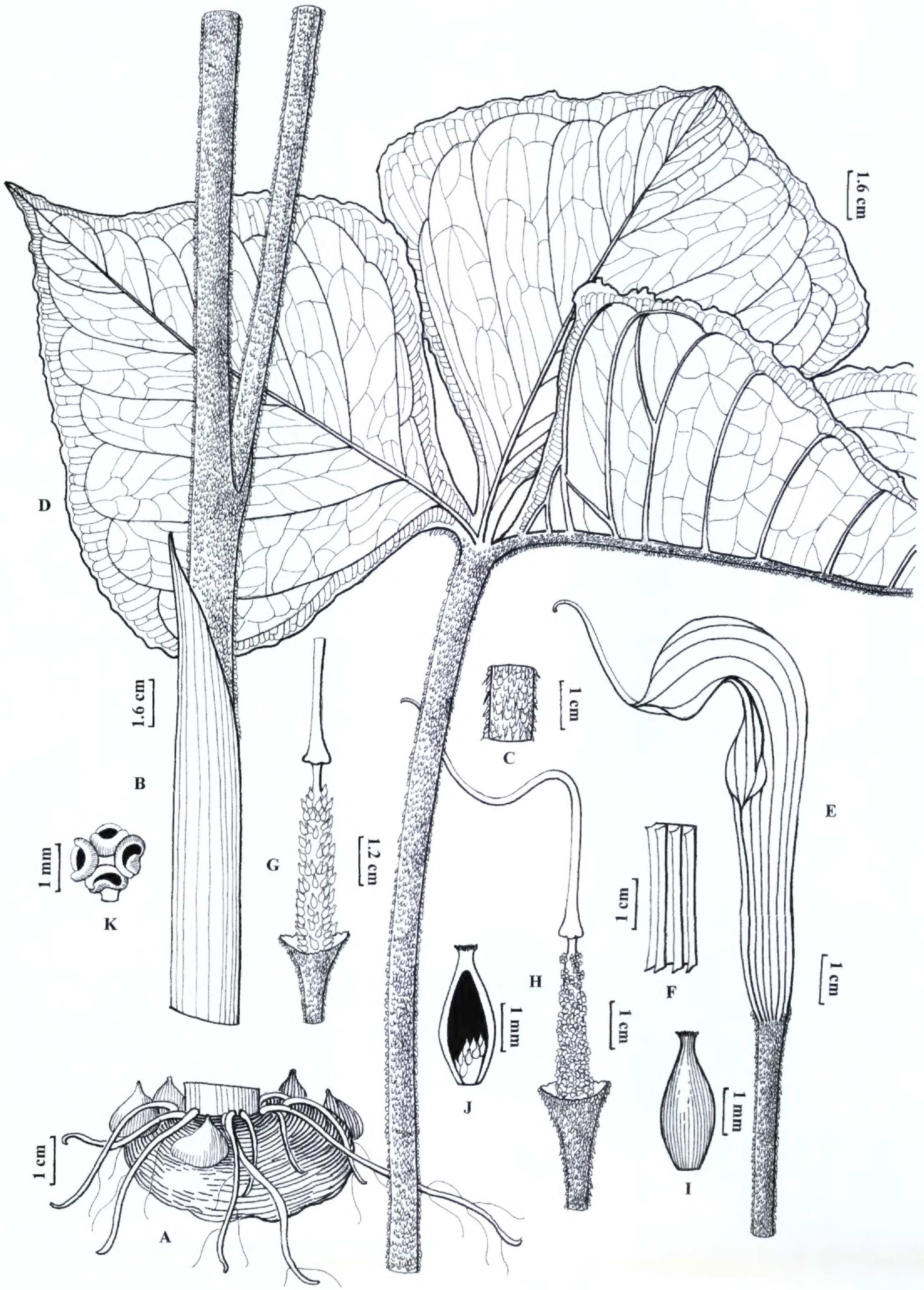


Figure 1. *Arisaema danzhuense* T. S. Yi & H. Li. —A. Tuber. —B. Part of peduncle showing cataphyll. —C. Part of peduncle showing verrucosities and spinules. —D. Leaflets. —E. Inflorescence. —F. Inner part of spathe showing laminae. —G. Female inflorescence. —H. Male inflorescence. —I. Pistil. —J. Longitudinal section of pistil showing ovules. —K. Synandrium. A–G, I, and J from *Heng, Bartholomew & Thomas et al. 12101* (female), and H, K from *Heng, Bartholomew & Thomas et al. 12102* (male). (Drawn by Wang Ling.)

(Li, 1979, 1987), in having anthers dehiscing by a horseshoe-shaped slit and the base part of the appendix swelling into a disk, and middle leaflets elliptic, ovate or rhombic, longer than wide. However, the latter species differs in having terminal leaflets with an acuminate apex, smooth petioles with small dark green or dark purple longitudinal stripes, a purple-spotted peduncle, and a purple spathe with whitish stripes and an acumen 2–3 cm. As species in the same section, *A. elephas* Buchet and *A. asperatum* N. E. Brown are similar to *A. danzhuense* in their peduncle and stem bearing verrucosities or spines, but the two species differ in having an obcordate or obdeltate middle leaflet, a dark purple spathe with whitish green stripes, and an acuminate spathe apex.

This new species is named after its type locality.

Paratypes. CHINA. **Yunnan:** Gongshan Xian, Danzhu, 3000 m, 1 July 2000, *Li Heng, Bruce Bartholomew & Philip Thomas et al. 12102* (KUN, E, MO).

Acknowledgments. The field expedition to the Gaoligong Mountains was supported by the National Natural Science Foundation of China (grant number 89670086), the National Geographic Society (grant number 6578–99), the California Academy of Sciences, and the Chinese Academy of Sciences (the Knowledge Innovation Project and grant number A-6). We are grateful to Li Dezhu for his comments and help in preparation of the manuscript, and to Wang Ling for preparing the illustration.

Literature Cited

Hara H. 1971. Araceae. Pp. 321–354 *in* The Flora of Eastern Himalaya. Univ. Tokyo Press, Tokyo.

Li, H. 1979. Araceae, Lemnaceae. *In* C. Y. Wu & H. Li, Flora Reipublicae Popularis Sinicae 13(2): 116–194. Science Press, Beijing.

———. 1980. Himalayas-Henduan Mountains, the center of distribution and differentiation of the genus *Arisaema*. *In* Ecological and Ecological Studies of Qinghai-Xizang Plateau Vol. II: 1321–1327. Science Press, Beijing.

———. 1987. Araceae. *In* C. Y. Wu, Flora Xizangica Vol. 5: 466–481. Science Press, Beijing.

———. 2000. Araceae. Pp. 1056–1067 *in* H. Li, Guo Huijun & Dao Zhiling, Flora of Gaoligong Mountains. Science Press, Beijing.

——— & Long Chun-Lin.1998. A preliminary revision of Araceae in China. Acta Bot. Yunn. Suppl. X: 12–23.

Mayo, S. J., J. Bogner & P. C. Boyce. 1997. Pp. 270–275 *in* The Genera of Araceae. Royal Botanic Gardens, Kew.

Murata, J. 1984. An attempt at an infrageneric classification of the genus *Arisaema* (Araceae). J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 13: 431–482.

Volume 11, Number 1, pp. 1–155 of NOVON was published on 30 April 2001.
Volume 11, Number 2, pp. 157–288 of NOVON was published on 10 July 2001.
Volume 11, Number 3, pp. 289–372 of NOVON was published on 21 September 2001.
Volume 11, Number 4, pp. 373–515 of NOVON was published on 7 December 2001.